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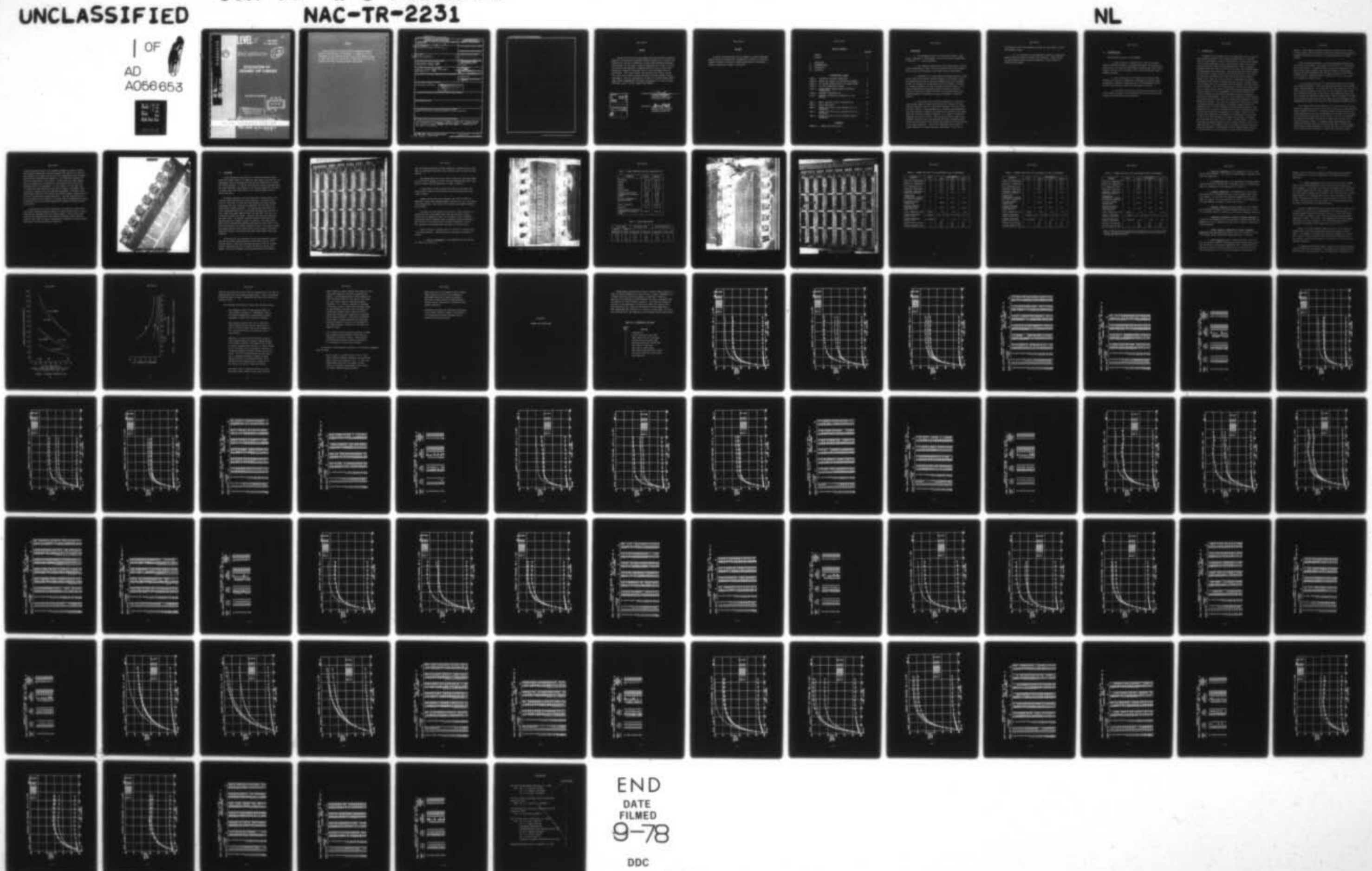

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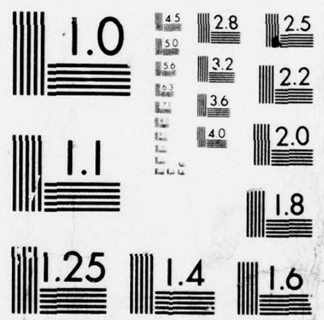

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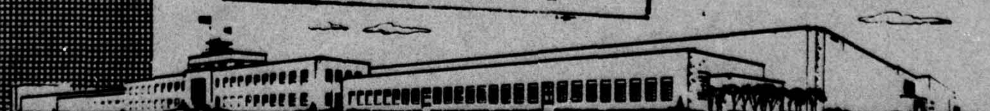

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A system of mounting dual in-line packages on ceramic substrates without the use of conventional through-holes is found to be feasible. Thermal information relating to substrate performance is developed. A protective coating for copper is discovered.

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PREFACE

The dual in-line microcircuit package (DIP) has exhibited increasing popularity with electronic equipment producers because of its inherent low package costs and ease of adaptation to high volume automated processing. Unfortunately, the DIP cannot always be adequately heat sinked to printed wiring boards when employed in component densities such as those often dictated by volumetric limitations found in high performance avionics applications. This study examines the feasibility of bringing the DIP into close contact with an alumina substrate to achieve thermal transfer improvements. Work was performed for the Naval Air Systems Command (NASC) under AIRTASK A03A360A/162B/7F21211000, sponsored by Mr. Francis Lueking (AIR-360A), and Mr. Charles Caposell (AIR-52022F).

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ABSTRACT

A system of mounting dual in-line packages on ceramic substrates without the use of conventional through-holes is found to be feasible. Thermal information relating to substrate performance is developed. A protective coating for copper is discovered.

TABLE OF CONTENTS

ILLUSTRATIONS & TABLES

APPENDICES

I. CONCLUSIONS

1. The packaging of dual in-line packages (DIPs) on large ceramic substrates or "motherboards" that do not contain through-holes is found to be technically feasible.

2. High conductor density thick film ceramic boards utilizing various combinations of dual in-line and ceramic chip carrier packages can be a low-cost alternative to multilayer printed wiring boards.

3. Adaptation of a single-sided DIP mounting concept on large ceramic modules would permit improved methods of "cold plate" cooling. The simplest form of such a cooling arrangement would be the passage of cool air through fins on the planar side of the module, resulting in increased turbulence and hence improved cooling efficiency. This form of mechanization would achieve improved avionics reliability through an increase in thermal efficiency in high power modules, and from elimination of localized hot spots on the faces of large area modules.

4. The present level of technical maturity of large multilayer ceramic modules (larger than 101.6 mm (four inches) per side) indicates that there are still significant technical risks due to producibility factors. Large manufacturers of ceramic substrates/modules are often inclined to ignore or not resolve such technical risks unless there are sufficient economic incentives, i.e., orders of hundreds of thousands or millions of parts. These large multilayer ceramics pose technical shortfalls due to differential shrinking of numerous layers during the firing process and the long paths required for the outgassing of the organic materials. Significant investments must be made in ceramic materials and associated processing aspects if costs are to

be reduced for very large substrates suitable for high numbers of thick film conductor layers.

5. It is possible to form protective coatings on copper that prevent oxidation without interfering with soldering. These coatings are formed during reverse sputtering operations in the presence of titanium and palladium.

II. RECOMMENDATIONS

These follow-on actions are recommended:

1. Survey industry to determine their level of technical interest, potential suppliers, and approximate module tooling and production costs. At least one large defense contractor has stated current interest and technical investigations into similar DIP/ceramic module packaging concepts.

2. After selections of the Standard Avionic Module (SAM) format(s) and size(s) are completed, a development contract(s) should be awarded to fabricate a minimum quantity of SAM-compatible ceramic carriers sufficient for further test and thermal evaluation.

3. Investigate the nature and potential applications of the coating formed on copper in the presence of titanium and palladium generated during reverse sputtering operations.

III. INTRODUCTION

Throughout the two-decade history of integrated circuits, there has been continuous evolution in the form and mechanization of integrated circuit (IC) packaging. Original simple analog IC circuits were packaged in round metal containers or cans, patterned after those used to house discrete transistor devices which they displaced. These IC packages contained additional leads or terminations to handle the increased numbers of input/output (I/O) connections. Time demonstrated that round packages were difficult to handle, test, and fabricate due to the circular grids and resulting holes/sockets that were required for lead insertion in order to test, fabricate, and, on occasion, troubleshoot and replace. The advent of the digital IC brought about the need for increased numbers of I/O terminations, and the popularity of the flatpack or butterfly package was enhanced. This form of mechanization offered radial leads brought out in a planar fashion, which also permitted improved packaging density through optimized I/O lead arrangements, but which unfortunately did little to improve the handling and attachment restraints presented by the earlier round packages. The dual in-line package was another approach to packaging the tiny microcircuit in a manner that provided an efficient mechanical interface. This form of IC packaging has exhibited an increasing popularity with various types of electronic system designers and packagers due to its simplified means of handling and interfacing, lower production costs, and ease of adaptation and use with automated handling and insertion equipments and automatic test systems. Almost all new devices being introduced by semiconductor IC manufacturers are packaged in DIPs, while fewer and fewer new devices are available in flatpacks, and almost none are being offered in small circular packages. The DIP has become the package standard of the IC industry and will remain so for some time due to the tremendous quantity consumed in industrial and home electronic equipments. Unfortunately, the DIP format presents two principal constraints to the high density, high performance Navy avionics

designer: DIPs cannot be packaged as densely as flatpacks (by a factor of two to three), and DIPs cannot be efficiently heat sinked to epoxy-glass printed wiring boards for purposes of achieving high rates of thermal transfer.

A new IC package technology is now being developed which may alleviate these two detriments, the ceramic chip carrier (C^3). This package, as its name implies, is formed of ceramic and the I/O terminations are merely solder bumps arranged around the base perimeter of the package. Packaging density improvements over DIP forms are achieved from eliminating the long lead terminations and by bringing I/O's out on four sides of the package as opposed to two.

It is anticipated that the C^3 IC package form factor will gain popularity among contractors in many high density applications such as random access computer memories. It is believed that chip carriers will not replace DIPs in <u>all</u> applications for some time, if ever; therefore, device types may not always be available in chip carrier form, making DIP devices the only available MIL-qualified package option. Avionics systems of the 1980's are envisioned to continue to use large quantities of DIP packages, often supplemented by ceramic chip carriers as qualified devices become available.

This project examined the feasibility of eliminating one of the two detriments presented by current DIP utilization, that of less-than-desirable thermal transfer efficiency. A principal project criterion was that the system developed must not only be compatible with the dual in-line package, but also with the ceramic chip carrier concept. Thus, the task examined the feasibility and hence practicality of combining DIPs with a good thermal conductor, alumina. A packaging concept was engineered that brought DIP packages into direct thermal contact with an alumina (Al_2O_3) carrier which had been fastened to a finned heat sink. The pin terminations of the DIP were shortened to a length that permitted a slight

extension beyond the body of the component package, as shown in Figure 1. The shortened terminations were then inserted into solder wells that had been placed in the alumina carrier, and this combination was then soldered for electrical and mechanical connection. This approach eliminated the need for through-holes in the alumina. Thermal paths were thus created from the underside of the component to the substrate and from the fore-shortened leads to the substrate. For the purposes of this study, thin film deposited interconnections were used to minimize the economic impact in lieu of a complex thick film substrate development. Increased circuit metallization densities could readily be achieved, however, through the use of thick film multilayer ceramic substrates. Two-piece connectors could also be attached to the substrate in the same form of solderfication process as were the DIPs, but this would degrade both thermal efficiency and packaging density.

During the course of the investigation, two industrial sources (3M and Ceramic Products) expressed interest in developing multilayer circuitry that would be compatible with this design approach. Each of these manufacturers has had experience with universal multilayer arrays, possibly ahead of their times in terms of technological acceptance, and have dropped the products from their marketing inventories.

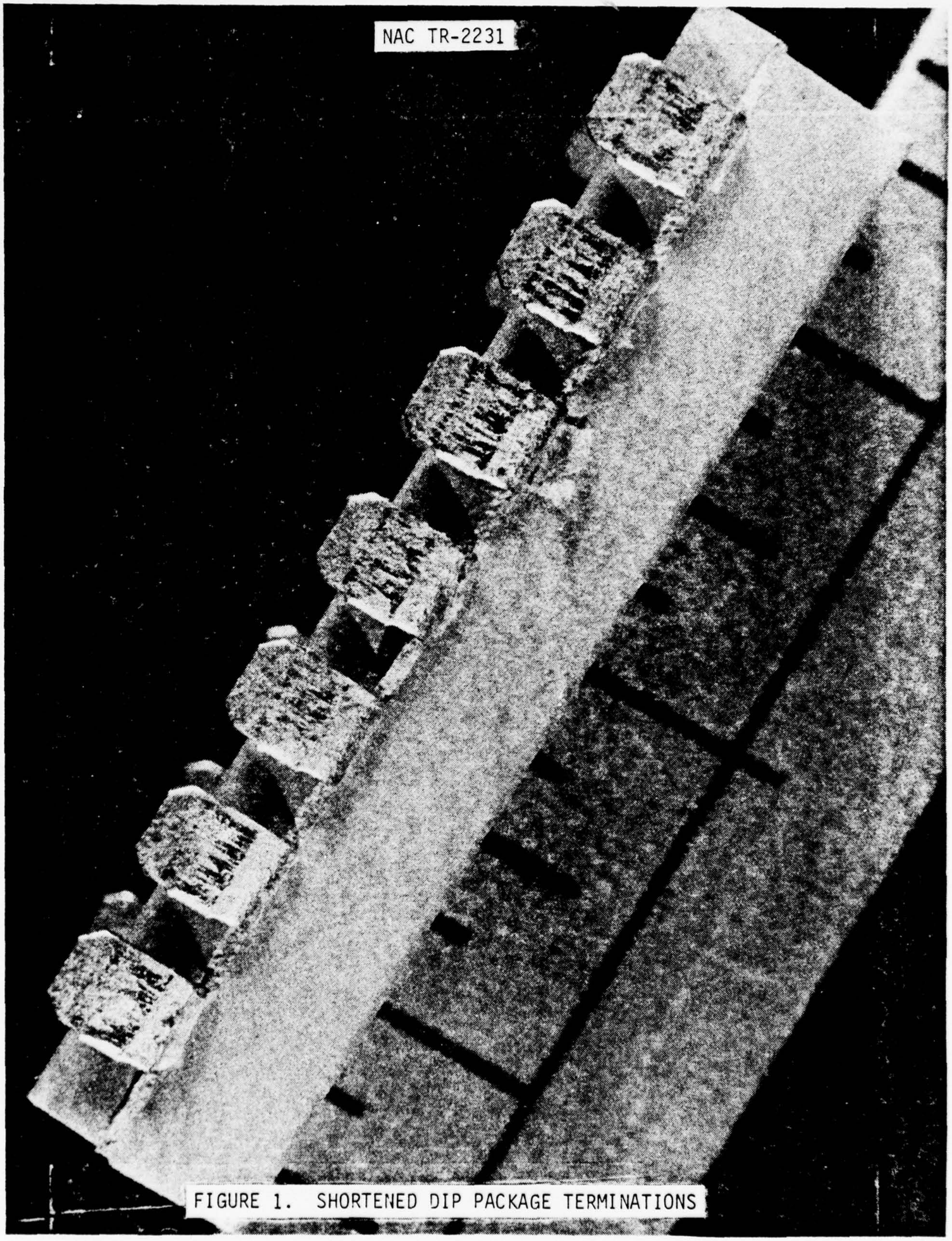


FIGURE 1. SHORTENED DIP PACKAGE TERMINATIONS

IV. DISCUSSION

A test package was constructed in a standard electronic module (SEM) XN-1 format, Figure 2, as materials were readily available for this experimental size and configuration and racking fixtures were available for testing purposes. In reality, the final form factor could have been any other convenient large substrate size that was compatible with metal or ceramic heat sinks using either air or liquid passages, and fins and/or heat pipes.

An alumina substrate, 101.6 mm square (four inches square), and 2.38 mm (0.093 inch) thick was used as the base. Cavities or wells 0.45 $\pm$ 0.7 mm (0.017 $\pm$ 0.003 inch) deep patterned to accept fourteen termination DIPs were ultrasonically machined into one side of the large ceramic alumina substrate. The substrate was then metallized with titanium-palladium alloy using sputtering deposition processes to form a metal-to-ceramic adhesion layer, and then this level was electrolytically plated with copper. Connector circuitry was etched into the copper layer, and then the remaining exposed titanium-palladium adhesion layer was removed by reverse sputtering. The shallow wells were filled by dipping the substrate into 60/40 tin/lead solder to complete fabrication of the ceramic connection levels. The reverse sputtering process produced a dark coating which did not prevent soldering or electrical contact, but protected the copper from further large scale oxidation.

Thirty-two DIPs and integrated circuits were prepared for mounting onto the ceramic substrate base by cutting the leads to 0.255 $\pm$ 0.013 mm (0.010 $\pm$ 0.005 inch) below the base side of the DIP package. The DIPs used were plastic due to their availability and low cost; however, ceramic DIP packages could have been equally well adapted.

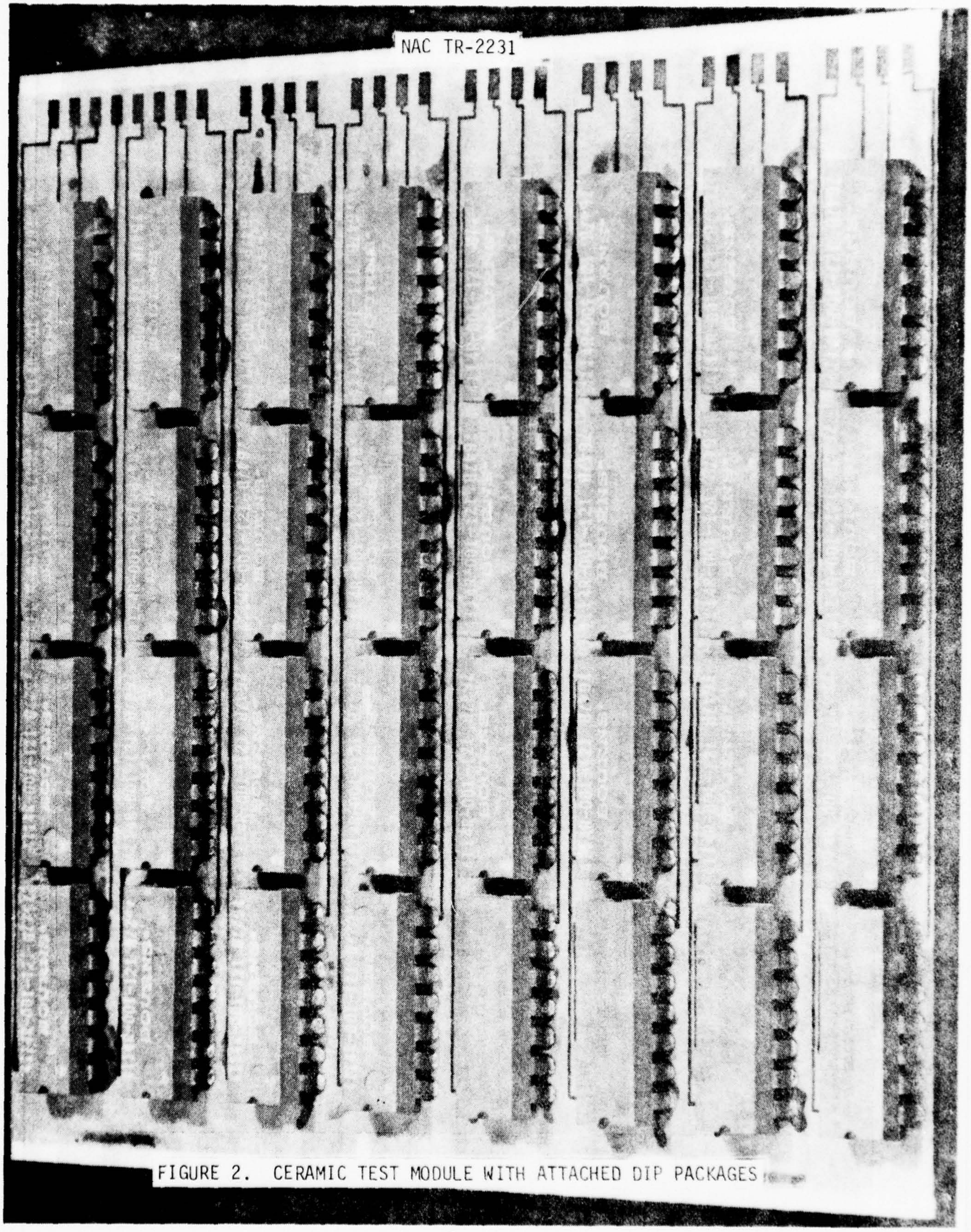


FIGURE 2. CERAMIC TEST MODULE WITH ATTACHED DIP PACKAGES

Each DIP package contained resistors mounted on a ceramic base to simulate the power/heat dissipation loads typically seen by large high power modules.

The prepared DIPs were set in place and the basic board was heated to allow the DIP packages to settle into the reflowed solder until they were in contact with the substrates, as shown in Figure 3.

A finned beryllia heat sink was then epoxied to the heat sink side to make a forced air-cooled module with the characteristics outlined in Table 1.

Thermal cycling tests were conducted from -65°C to +125°C to determine if there were damaging thermal stresses built up in the mechanical configuration. Test results did not depict any apparent damage to the structure.

The module was then encased in two inches of foam insulation to prevent heat loss by any means other than the cooling air supply. Cooling air was supplied at rates of 3.18 kg/hour (0.117 lb/minute), 2.10 kg/hour (0.077 lb/minute), and 1.61 kg/hour (0.0592 lb/minute) at 25°C for each of the various power conditions described in Table 2. The locations of the thermocouples are shown in Figures 4 and 5.

Tables 3 through 5 summarize data for cooling air supplies shown in the table headings. Items addressed by the tables are defined as follows:

1. Inlet air temperature is the temperature of the cooling air used in this test run.

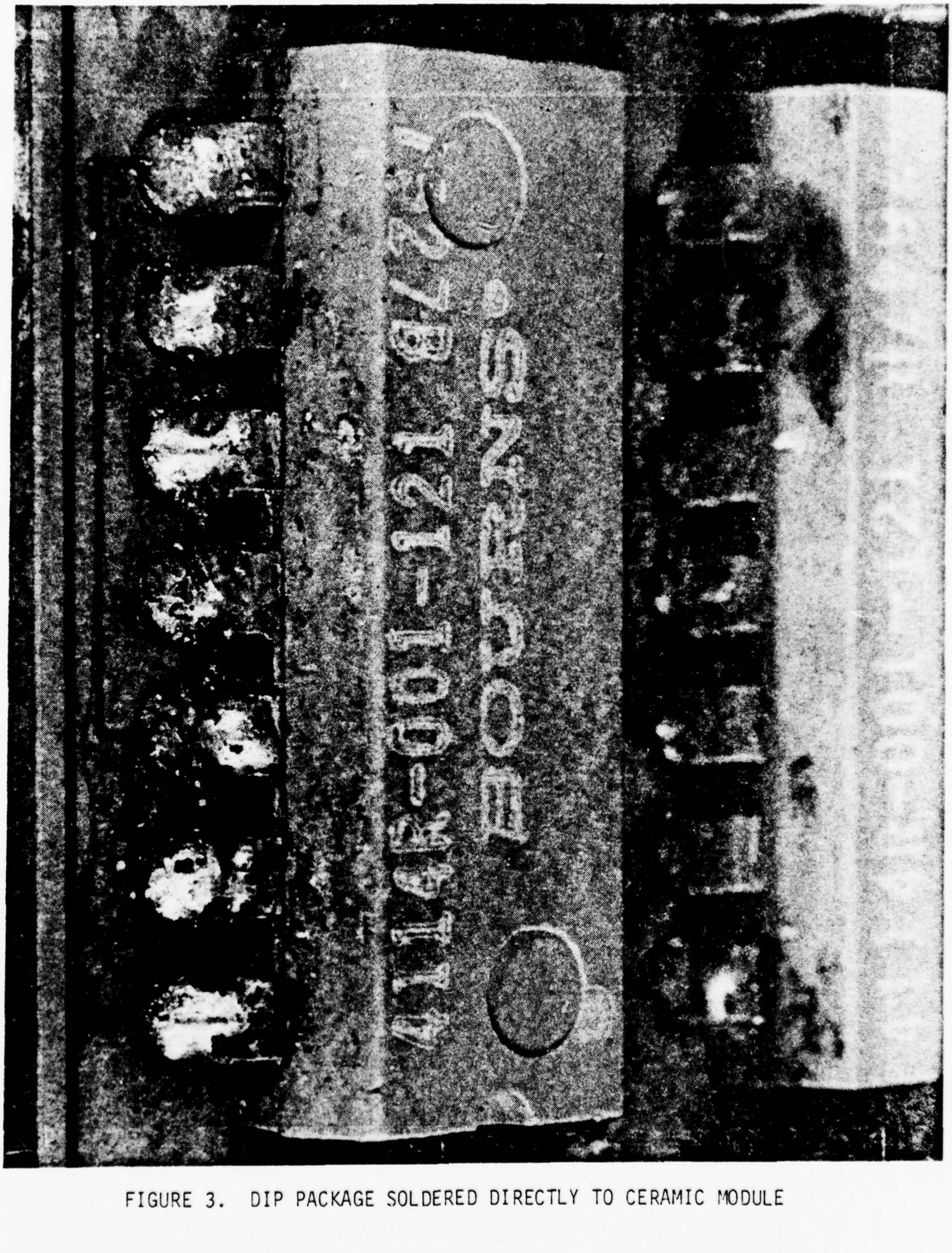


FIGURE 3. DIP PACKAGE SOLDERED DIRECTLY TO CERAMIC MODULE

TABLE 1. MODULE SUBSTRATE PHYSICAL CHARACTERISTICS

PARAMETER	METRIC	ENGLISH
Thickness	1.21 cm	0.475 in.
Height	10.2 cm	4.00 in.
Width	10.2 cm	4.00 in.
Weight	190 g	0.419 lb.
Active Area	83.9 cm^3	13 in^2
Pins/in^2 Active Area (Dependent on Connector used)	5.84 13.27 26.54	5.84 13.27 26.54
Pins/IC (Dependent on Connector Used)	2.37 4.75 9.50	2.37 4.75 9.50
Total Volume/DIP	1.61 cm^3	0.250 in^3
Weight/IC	5.94 g	0.013 lb.
Insertion/Extraction Force (Dependent on Connector Used)	0-334 N	0-75 lb.

TABLE 2. POWER CONDITIONING

TOTAL POWER		DISTRIBUTED LOAD		LOAD CONCENTRATION	
DENSITY WATTS/IN^3	POWER WATTS	WATTS/CM^2	WATTS/IN^2	WATTS/CM^2	WATTS/IN^2
6.25	50	0.48	3.13	6.20	40
3.12	25	0.24	1.56	3.10	20
1.56	12.5	0.12	0.78	1.55	10

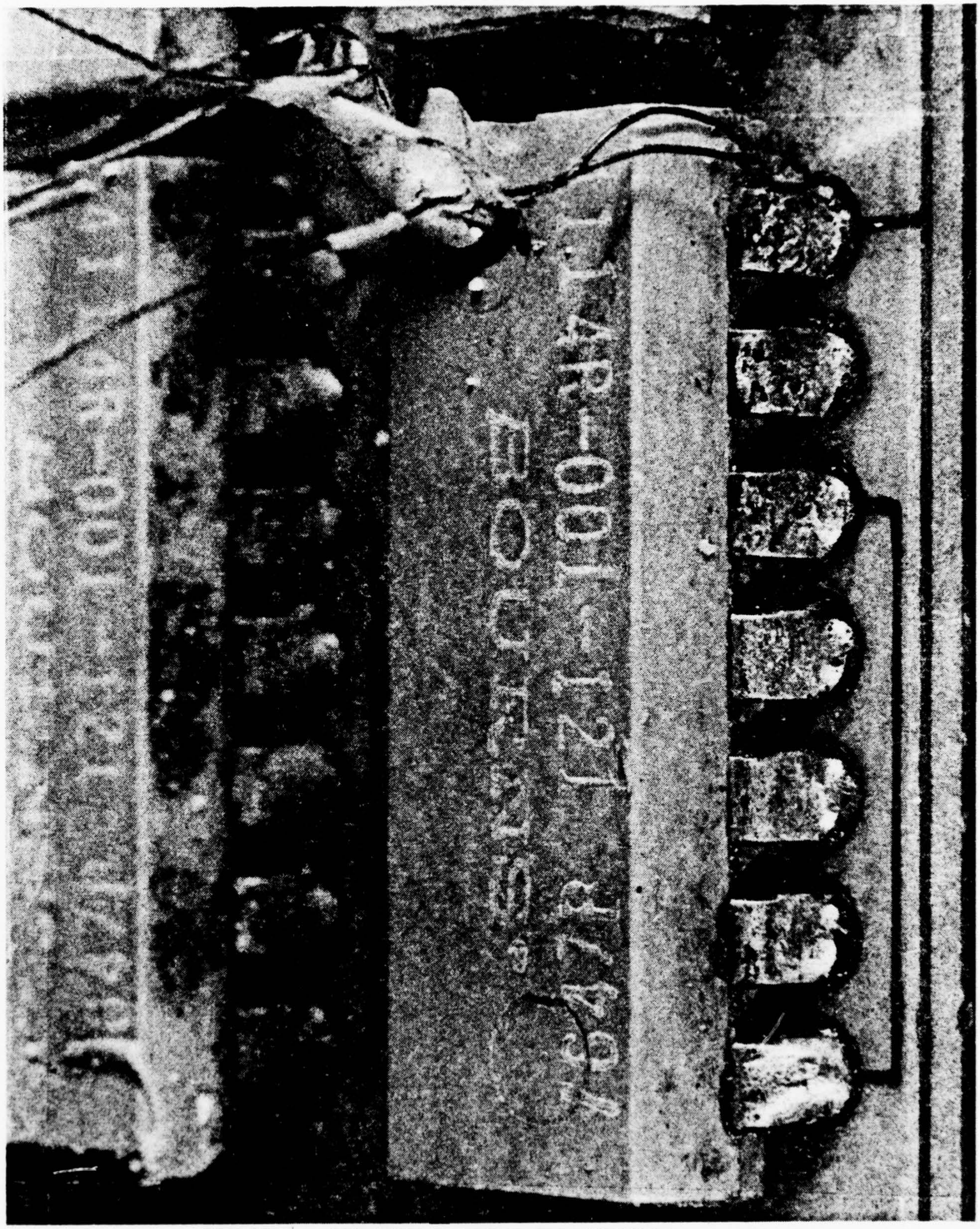


FIGURE 4. DIP WITH THERMOCOUPLE ATTACHED

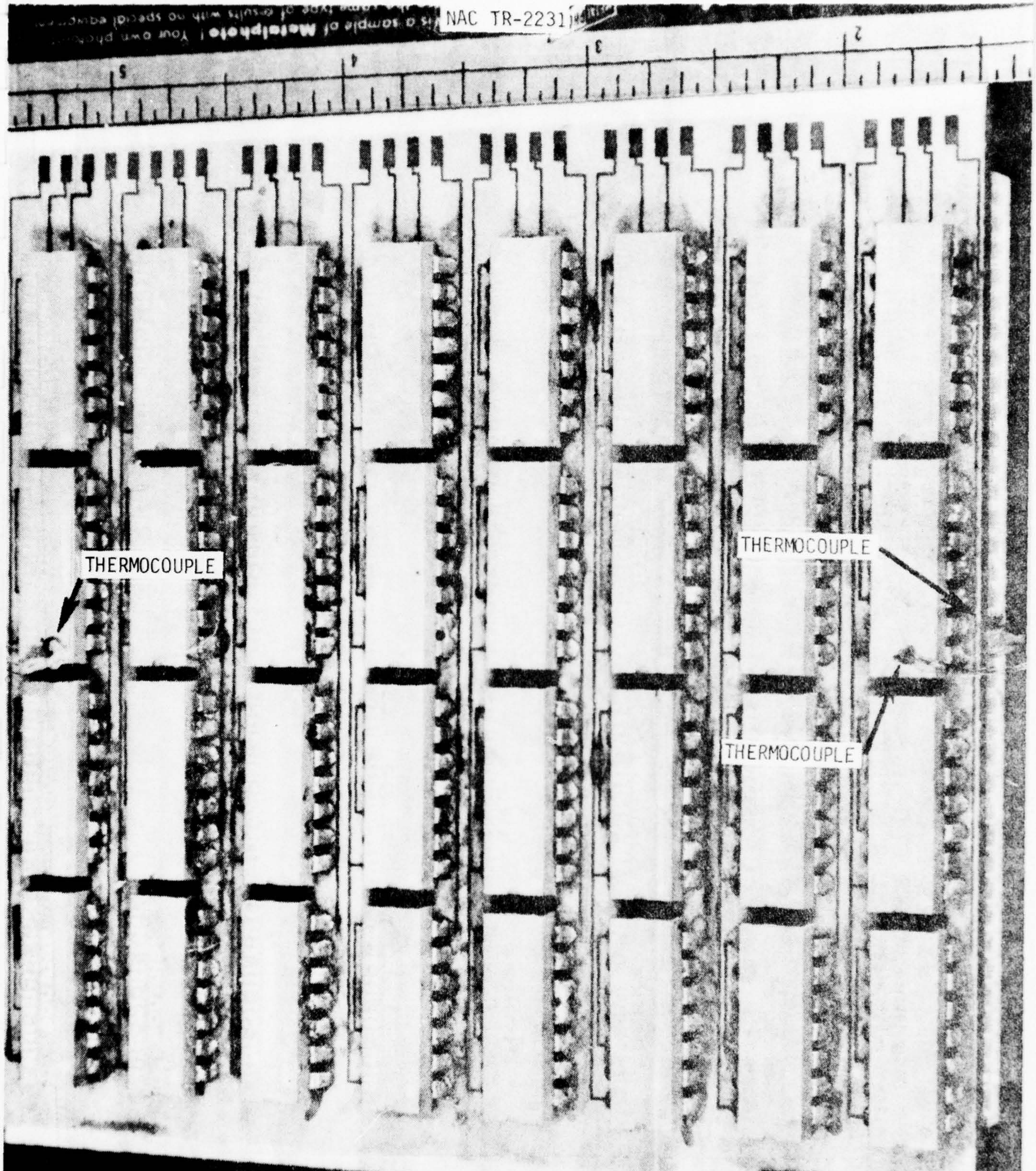


FIGURE 5. CERAMIC MODULE SHOWING RELATIVE POSITION OF THERMOCOUPLES

TABLE 3. THERMAL TESTS WITH 3.18 kg AIR/HOUR (0.117 lb AIR/MINUTE)

PARAMETER	UNITS	LOAD (WATTS)		
		50	25	12.5
Inlet Air Temperature	°C	25.3	24.4	22.6
Outlet Air Temperature	°C	82.7	52.8	36.7
Air Temperature Rise	°C	57.4	28.4	14.6
Component Temperature	°C	93.6	58.3	39.8
Component Temperature Rise over Inlet Air	°C	68.3	33.9	17.2
Temperature Differential (Coolest to Hottest Component)	°C	13.9	6.2	3.1
Average Component Temperature	°C	86.65	55.2	38.25
Average Component Temperature Rise over Inlet Air	°C	61.35	30.8	15.65
Total Temperature Rise	°C/Watt	1.37	1.36	1.38
Thermal Resistance (Unit to Air)	$K \cdot m^2$/Watt	11.0×10^{-4}	10.9×10^{-4}	11.1×10^{-4}
Thermal Resistance (Unit to Air)	°C in^2/Watt	1.71	1.70	1.72
Thermal Time Constant	S	240	178	105
Thermal Response Time	S	693	545	482

TABLE 4. THERMAL TESTS WITH 2.10 kg AIR/HOUR (0.0770 lb AIR/MINUTE)

PARAMETER	UNITS	LOAD (WATTS) 50	25	12.5
Inlet Air Temperature	°C	28.3	25.6	23.4
Outlet Air Temperature	°C	111.6	68.1	44.8
Air Temperature Rise	°C	83.3	42.5	21.4
Component Temperature	°C	121.2	73.1	47.3
Component Temperature Rise over Inlet Air	°C	92.9	47.5	23.9
Temperature Differential (Coolest to Hottest Component)	°C	17.9	8.2	4.0
Average Component Temperature	°C	112.25	69.0	45.3
Average Component Temperature Rise over Inlet Air	°C	83.95	43.4	21.9
Total Temperature Rise	°C/Watt	1.86	1.90	1.91
Thermal Resistance (Unit to Inlet Air)	$K \cdot m^2$/Watt	15.0×10^{-4}	15.3×10^{-4}	15.4×10^{-4}
Thermal Resistance (Unit to Inlet Air)	°C in^2/Watt	2.32	2.38	2.39
Thermal Time Constant	S	323	287	131
Thermal Response Time	S	1070	907	671

TABLE 5. THERMAL TESTS WITH 1.61 kg AIR/HOUR (0.0592 lb AIR/MINUTE)

PARAMETER	UNITS	LOAD (WATTS)		
		50*	25	12.5
Inlet Air Temperature	°C	32.7	27.4	25.6
Outlet Air Temperature	°C	122.8	73.0	49.5
Air Temperature Rise	°C	90.1	45.6	23.9
Component Temperature	°C	137.9	79.7	52.6
Component Temperature Rise over Inlet Air	°C	105.2	52.3	27.0
Temperature Differential (Coolest to Hottest Component)	°C	25.2	10.5	4.4
Average Component Temperature	°C	125.3	74.4	50.4
Average Component Temperature Rise over Inlet Air	°C	92.6	47.0	24.8
Total Temperature Rise	°C/Watt	2.10	2.09	2.16
Thermal Resistance (Unit to Inlet Air)	$K \cdot m^2/Watt$	17.0×10^{-4}	16.9×10^{-4}	17.4×10^{-4}
Thermal Resistance (Unit to Inlet Air)	°C $in^2/Watt$	2.63	2.61	2.70
Thermal Time Constant	S	242	345	304
Thermal Response Time	S	506*	1186	1011

*This run had to be discontinued with the temperature still rising at 0.4°C/minute. Calculations are based on the last data points rather than being extrapolated beyond the data.

2. Outlet air temperature is the temperature of the air upon exiting from the module. This value will approximately correspond to the inlet air temperature.

3. Air temperature rise is the temperature difference between inlet and outlet air, and provides a convenient value for estimating the outlet air temperature at new temperatures of inlet air.

4. Component temperature is the temperature of the hottest heat source and is a controlling factor in the allowable power rating of the module. In the case of the proposed standard avionics module (SAM), for example, this value has been set at 85^{o}C. This temperature will approximately correspond to that of the inlet air.

5. Component remperature rise over inlet air is the temperature differential between the hottest component and the inlet air, and is a convenient value for estimation of the maximum component temperature.

6. Temperature differential (coolest to hottest component) is a measure of the freedom that can be exercised in locating more than one temperature-critical component that must track a similar or functionally related component.

7. Average component temperature and average component temperature rise over inlet air provide a means for estimating ratings on an average rather than maximum temperature basis, if desired.

8. Total temperature rise is stated in degrees celsius per watt and provides a means of rating modules based on total power, available cooling air, and allowable temperature rise. Uniformity of this value for a given air flow is a measure of the accuracy of the test. The increasing value, 1.37 ^{o}C/W for 3.18 kg/hour, 1.89 ^{o}C/W for 2.10

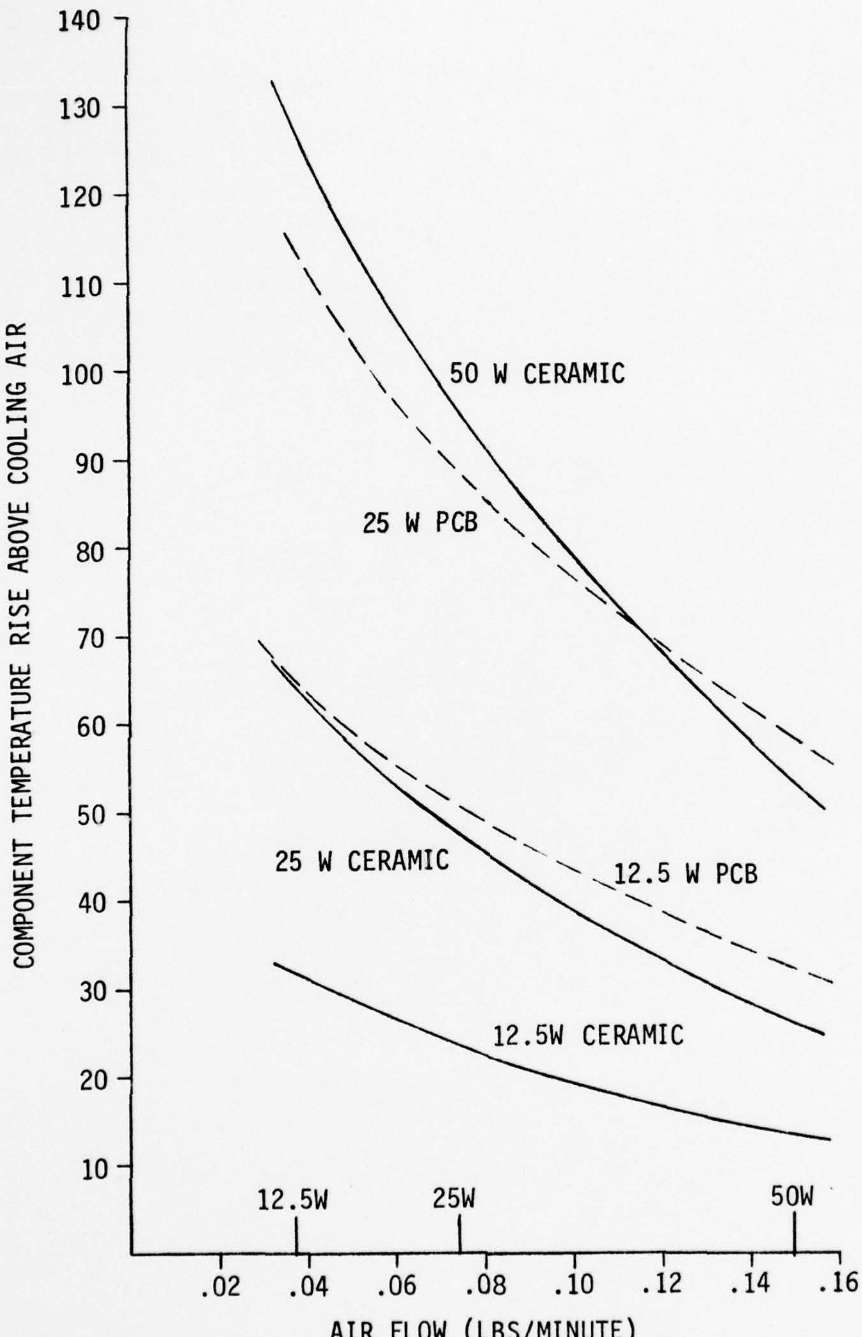
kg/hour, and 2.12 $^{o}C/W$ for 1.61 kg/hour indicates decreasing turbulence with decreasing air flow and, consequently, decreasing heat transfer capability.

9. Thermal resistance provides a more accurate means of module rating if the load concentration in watts per unit area is known for a given component. In the test, this value was 6.20 W/cm^2 (6.20×10^{-4} W/m^2) for a 50-watt module thermal loading factor; 3.10 W/cm^2 (3.10×10^{-4} W/m^2) for 25-watt module loading; and 1.55 W/cm^2 (1.55×10^{-4} W/m^2) for 12.5-watt module loading. The resulting power ratings (load concentration times thermal resistance) are 43.80 W for 3.18 kg air/hour, 31.75 W for 2.10 kg air/hour, and 28.35 W for 1.61 kg air/hour; if limiting temperatures are the same as those proposed for SAM-type modules.

In order to demonstrate the use of the graphs given in Figures 6 and 7, consider a flow rate of 0.04 pounds/minute. At this flow rate, the maximum component temperature rise above inlet air is 30^{o}C from Figure 6. If the cooling air supply is 30^{o}C, then the resulting maximum component temperature is 60^{o}C. From Figure 7, the temperature differential between the hottest and coolest component is 5^{o}C, indicating that placement of components on the module at this power level is not critical.

Figure 6 also shows component temperature rise for DIPs mounted on aluminum rails on printed wiring boards having solid power and ground planes. The assembly is equipped with finned heat exchangers at the rail ends. Data for these curves were drawn from private contractor sources and indicate a two-to-one improvement of the ceramic DIP carrier over conventional packaging.

The temperature difference between the hottest and coolest component indicates some level of improvement. For example, with 0.08 pounds/minute of cooling air and 50 watts total load, the temperature differentials are



Typical military requirement for 25°C cooling air is indicated at each power level

FIGURE 6. COMPONENT TEMPERATURE RISE

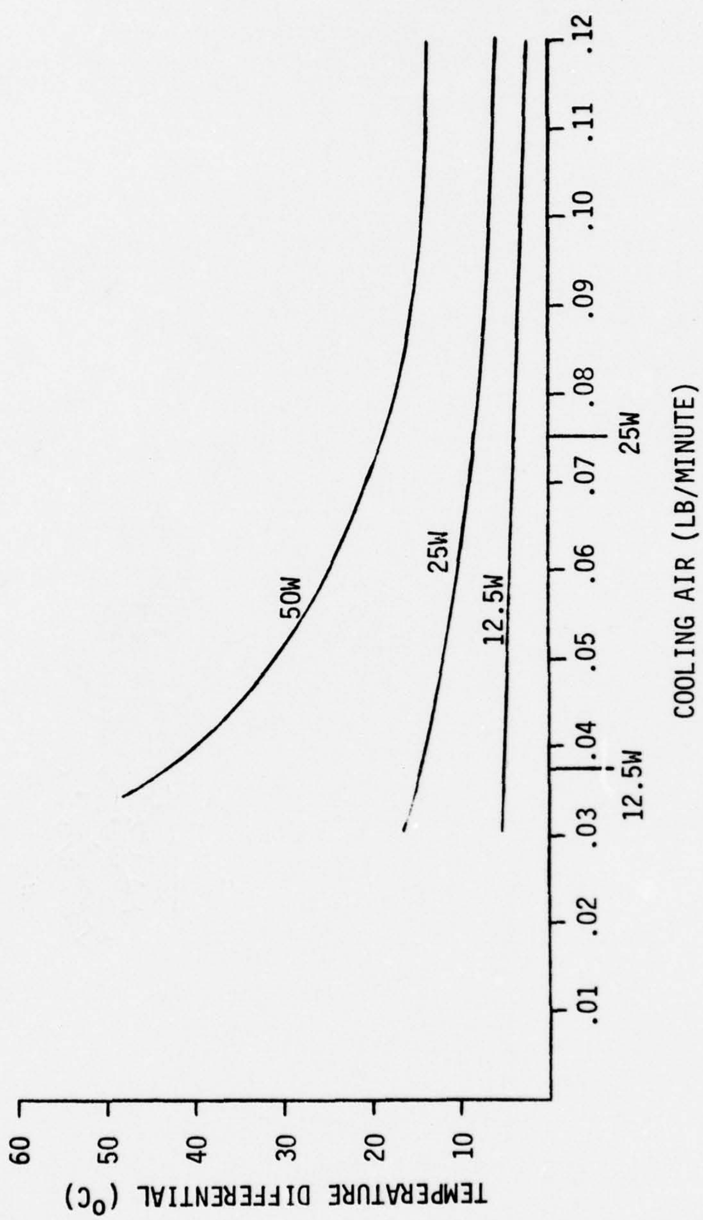


FIGURE 7. COMPONENT TEMPERATURE DIFFERENTIAL VS. AIR SUPPLIES

18^{o}C for the ceramic DIP carrier, 58^{o}C for aluminum rails, and 36^{o}C for aluminum rails and solid ground and power planes. There is no printed wiring board plot on Figure 7 because the data were not sufficient to generate a curve.

The following conclusions were drawn from the above testing:

- The packaging of dual in-line packages (DIPs) on large ceramic substrates or "motherboards" that do not contain through-holes to gain thermal transfer advantages is found to be technically feasible.

- High conductor density thick film or multilayer ceramic boards utilizing various combinations of dual in-line and ceramic chip carrier packages can be a low-cost alternative to multilayer printed wiring boards.

- Adoption of a single-sided DIP mounting concept on large ceramic modules would permit improved methods of "cold plate" cooling. The simplest form of such a cooling arrangement would be cool air forced through fins on the planar side of the module, resulting in increased turbulence and hence improved cooling efficiency. This form of mechanization would be beneficial in improving reliability through increased thermal efficiency in high power modules, and by providing uniform temperatures by elimination of hot spots on the faces of large area modules.

- The present level of technical maturity of large multilayer ceramic modules (larger than 101.66 mm

(four inches) per side) indicates that there are still significant technical risks due to producibility factors. Large manufacturers of ceramic modules are often inclined to ignore or not resolve such technical risks unless there are sufficient economic incentives, i.e., orders of hundreds of thousands or millions of parts. These large multilayer ceramics pose technical shortfalls due to differential chrinking of numerous layers during the firing process and the long paths required for outgassing of the organic materials. Significant investments must be made in ceramic materials and associated processing aspects if costs are to be reduced for very large substrates suitable for high numbers of conductor layers.

- It is possible to form protective coatings on copper that prevent oxidation without interfering with soldering or electrical contact. These coatings are formed during reverse sputtering operations in the presence of titanium and palladium.

On the basis of the preceding conclusions, the following recommendations are made:

- Survey industry to determine their level of technical interest, potential suppliers, and approximate module tooling and production costs. At least one large defense contractor has stated a current interest in technical investigations into similar DIP ceramic module packaging concepts.

- After selections of the standard avionics module (SAM) format(s) and size(s) are completed, a development contract(s) should be awarded to fabricate a minimum quantity of SAM-compatible ceramic carriers sufficient for further test and thermal evaluation.

- Investigate the nature and potential applications of the coating formed on copper in the presence of titanium and palladium, generated during reverse sputtering operations.

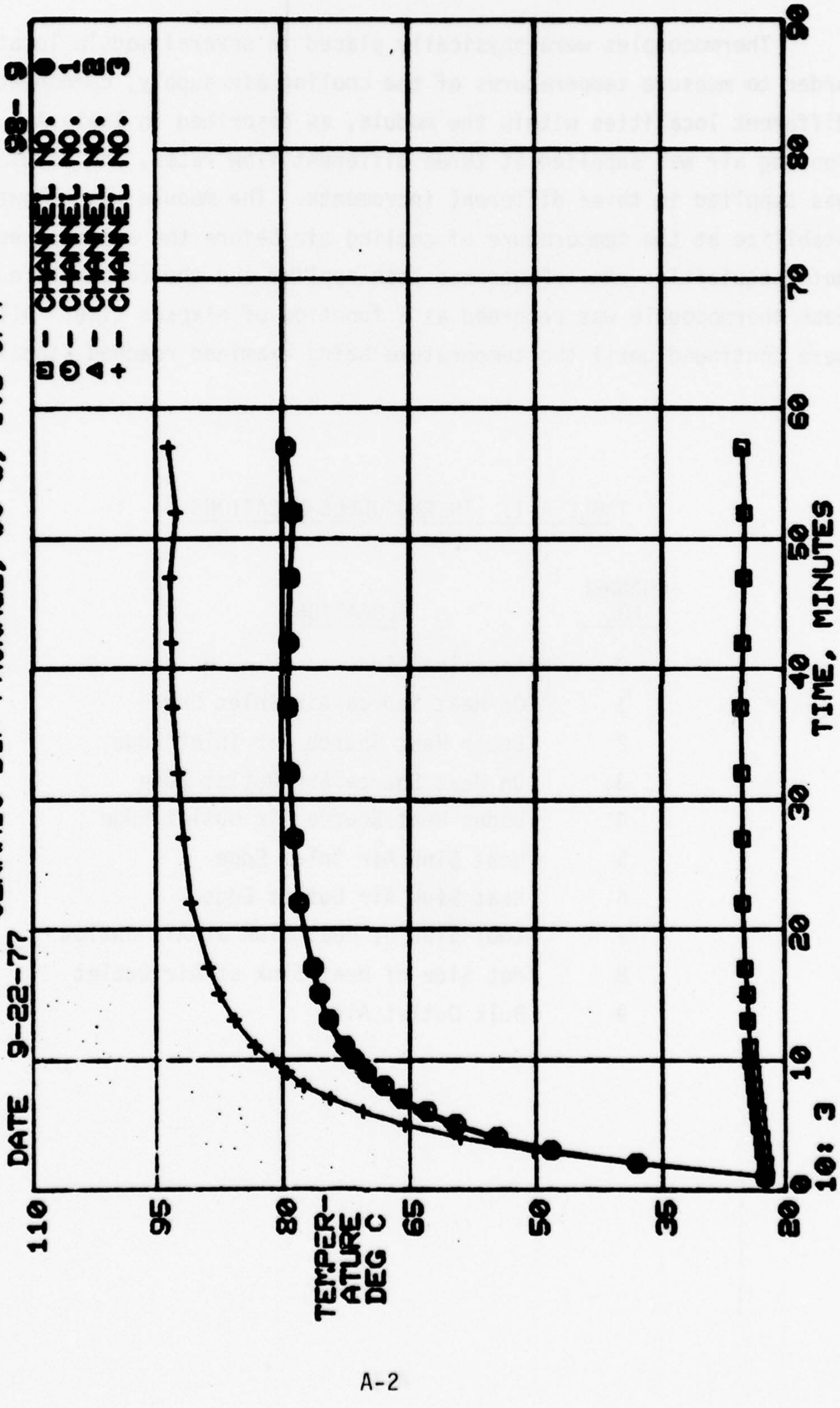
APPENDIX A

THERMAL DATA ACQUISITION

Thermocouples were physically placed in several module locations in order to measure temperatures of the cooling air supply, components, and different localities within the module, as described in Table A-1. Cooling air was supplied at three different flow rates, and module power was supplied in three different increments. The module was allowed to stabilize at the temperature of cooling air before the start of each data acquisition run. Power was then applied and the temperature of each thermocouple was recorded as a function of elapsed time. All plots were continued until the temperature being examined reached stabilization.

TABLE A-1. THERMOCOUPLE LOCATIONS

CHANNEL NO.	LOCATION
0	Incoming Air
1	On Heat Source Air Inlet Edge
2	Under Heat Source Air Inlet Edge
3	On Heat Source Air Outlet Edge
4	Under Heat Source Air Outlet Edge
5	Heat Sink Air Inlet Edge
6	Heat Sink Air Outlet Edge
7	Cool Side of Heat Sink at Air Outlet
8	Hot Side of Heat Sink at Air Outlet
9	Bulk Outlet Air



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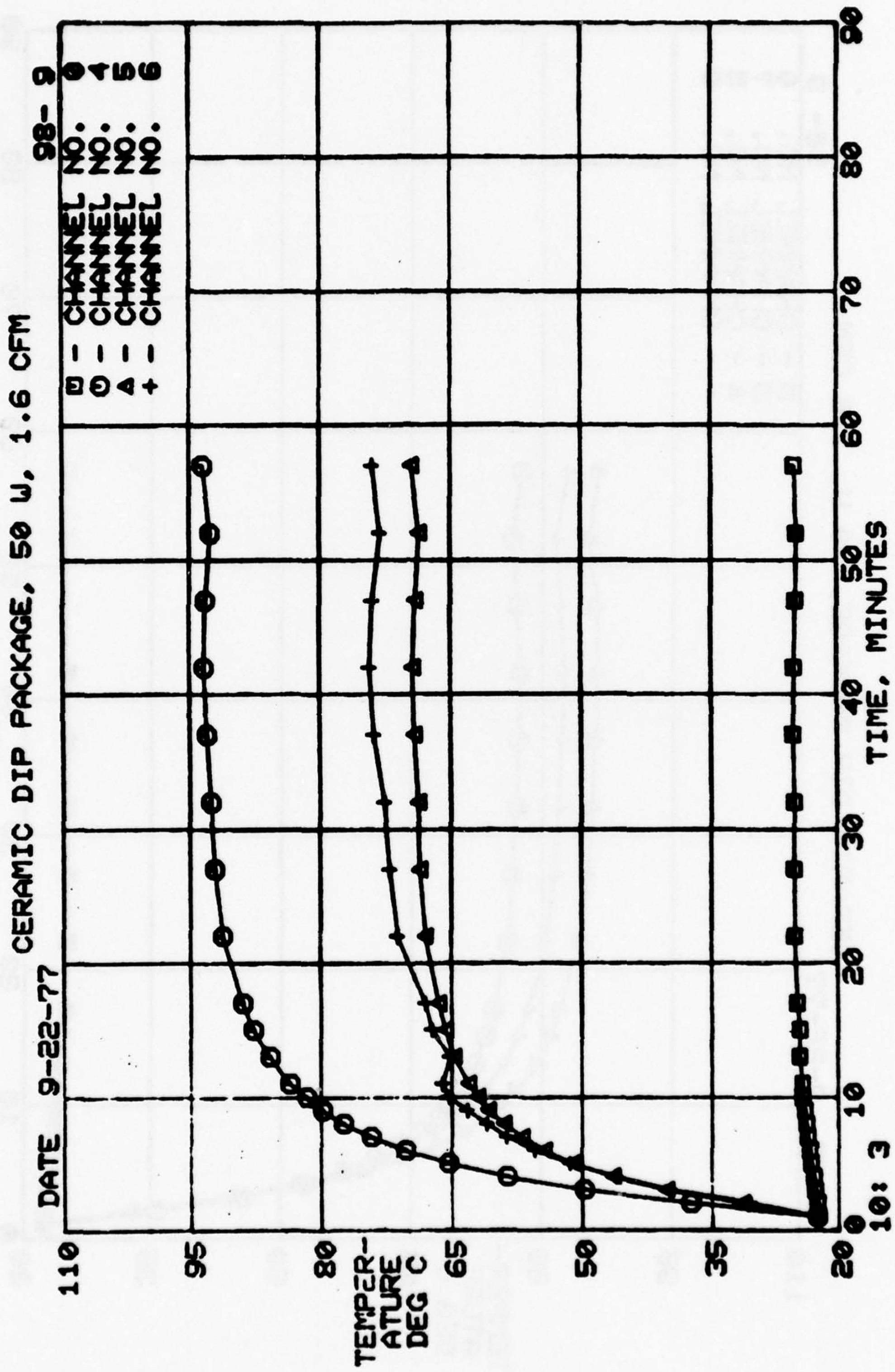
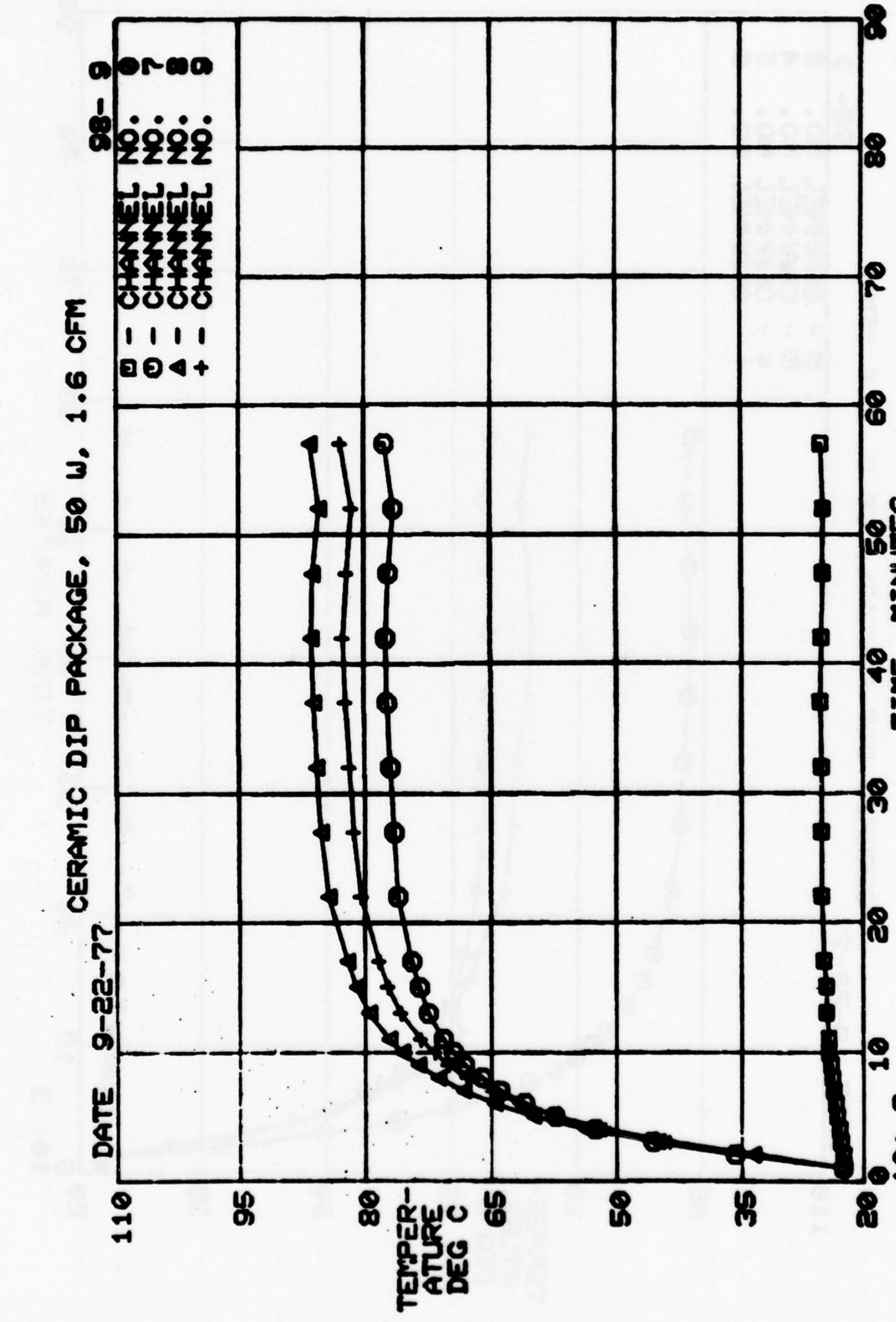
90
TIME, MINUTES
10: 3



CERAMIC DIP PACKAGE, 50 W, 1.6 CFM
DATE 9-22-77
98- 9
□ - CHANNEL NO. 3
⊙ - CHANNEL NO. 4
△ - CHANNEL NO. 5
+ - CHANNEL NO. 6
TEMPER-
ATURE
DEG C
110
95
80
65
50
35
20
10: 3
0
10
20
30
40
50
60
70
80
90
TIME, MINUTES



DATE 9-22-77
CERAMIC DIP PACKAGE, 50 W, 1.6 CFM
98- 9
□ – CHANNEL NO. 6
⊙ – CHANNEL NO. 7
△ – CHANNEL NO. 8
+ – CHANNEL NO. 9
110
95
80
65
50
35
20
TEMPER-
ATURE
DEG C
0
10
20
30
40
50
60
70
80
90
10: 3
TIME, MINUTES

CERAMIC DIP PACKAGE, 50 W, 1.6 CFM

TEST STARTING DATE: 9-22-77 REQ. NO. 98 RUN NO. 9

SCAN	HR:MN	ELAPSED TIME	CHANNEL NUMBER 0	1	2	3	4	5
1	10: 3	0	22.4C	22.4C	22.4C	22.4C	22.4C	22.4C
2	10: 4	1	22.4C	22.4C	22.4C	22.4C	22.4C	22.4C
3	10: 5	2	22.4C	38.1C	38.2C	38.5C	37.4C	31.4C
4	10: 6	3	22.7C	48.2C	48.4C	50.3C	49.7C	40.3C
5	10: 7	4	22.9C	54.6C	55.2C	59. C	58.6C	46.5C
6	10: 8	5	23.2C	59.6C	60.1C	65.7C	65.4C	51.1C
7	10: 9	6	23.3C	63. C	63.7C	70.6C	70.4C	54.4C
8	10:10	7	23.7C	66. C	66.4C	74.5C	74.3C	56.9C
9	10:11	8	23.8C	68. C	68.7C	77.6C	77.5C	59.1C
10	10:12	9	24. C	70.2C	70.6C	79.7C	79.9C	60.8C
11	10:13	10	24.2C	71.6C	71.9C	81.4C	81.7C	62.1C
12	10:14	11	24.3C	72.7C	73.1C	83.3C	83.6C	63.2C
13	10:16	13	24.6C	74.6C	74.8C	85.7C	85.9C	64.8C
14	10:18	15	24.5C	75.7C	75.8C	87.6C	87.9C	65.8C
15	10:20	17	24.8C	76.5C	76.6C	88.8C	89. C	66.5C
16	10:25	22	25.1C	78.2C	78.2C	90.9C	91.3C	68.1C
17	10:30	27	25.2C	78.7C	78.7C	91.8C	92.2C	68.6C
18	10:35	32	25.1C	79.1C	79.1C	92.4C	92.7C	68.9C
19	10:40	37	25.3C	79.4C	79.4C	93. C	93.1C	69.3C
20	10:45	42	25.1C	79.4C	79.5C	93.2C	93.4C	69.4C
21	10:50	47	25. C	79.2C	79.2C	93.4C	93.2C	69.1C
22	10:55	52	24.9C	78.8C	78.7C	92.7C	92.6C	68.6C
23	11: 0	57	25.2C	79.7C	79.6C	93.6C	93.6C	69.6C

CERAMIC DIP PACKAGE, 50 W, 1.6 CFM

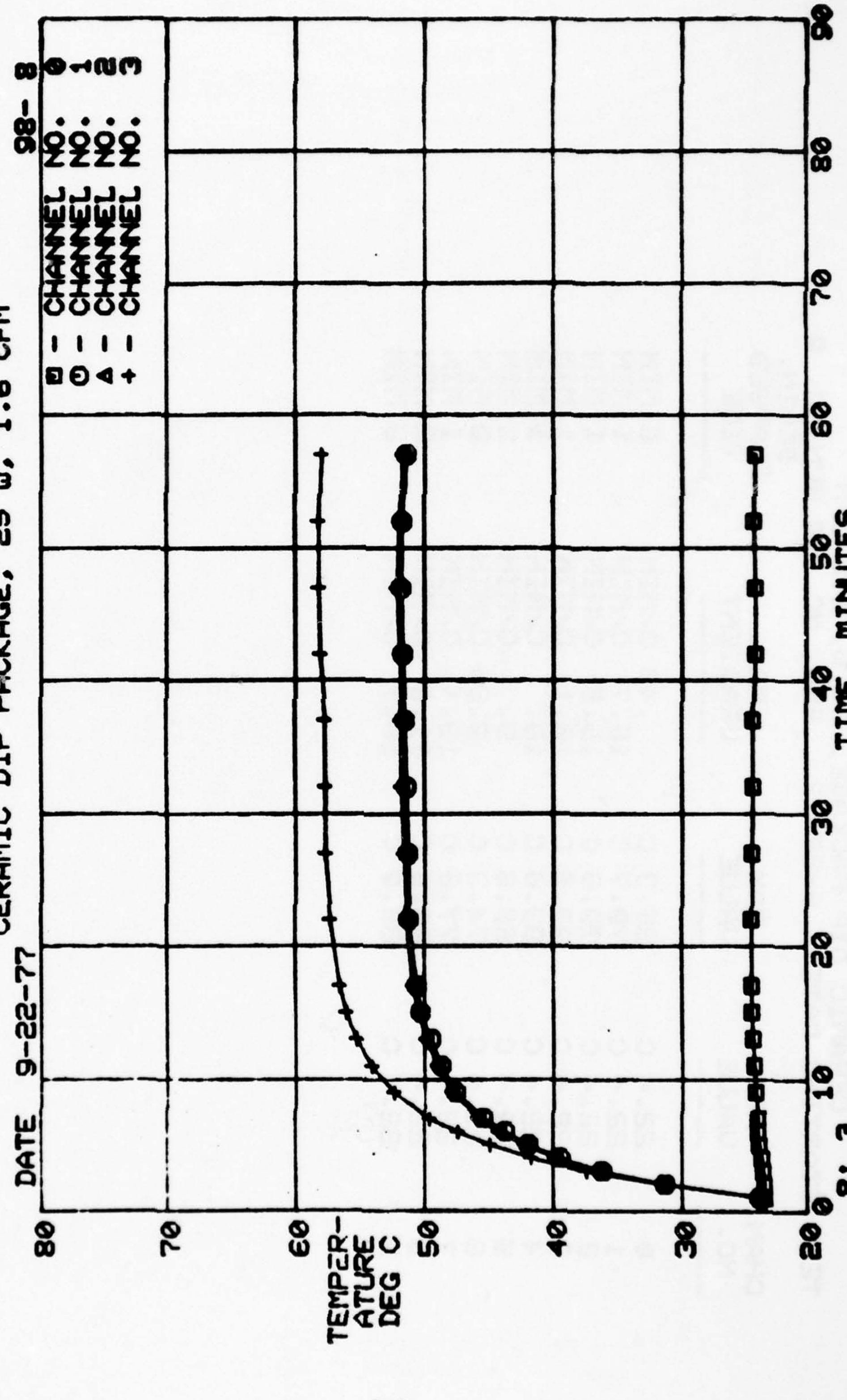
TEST STARTING DATE: 9-22-77 REQ. NO. 98 RUN NO. 9

SCAN	HR:MN	ELAPSED TIME	CHANNEL NUMBER 6	7	8	9
1	10: 3	0	22.4C	22.4C	22.4C	22.4C
2	10: 4	1	22.4C	22.4C	22.4C	22.4C
3	10: 5	2	30.6C	35.8C	33.5C	33. C
4	10: 6	3	39.8C	45.7C	45.1C	43.7C
5	10: 7	4	46.1C	52.6C	53.6C	51.4C
6	10: 8	5	51.4C	57.4C	59.9C	57.1C
7	10: 9	6	55.4C	61.1C	64.6C	61.4C
8	10:10	7	58.8C	64. C	68.3C	64.9C
9	10:11	8	61.1C	66.2C	71.3C	67.9C
10	10:12	9	63.3C	68.2C	73.8C	70.2C
11	10:13	10	65.3C	69.6C	75.7C	71.9C
12	10:14	11	66.1C	70.8C	77.2C	73.5C
13	10:16	13	65.2C	72.6C	79.6C	75.8C
14	10:18	15	67.3C	73.7C	81.1C	77.3C
15	10:20	17	68. C	74.5C	82.2C	78.4C
16	10:25	22	71.2C	76.2C	84.4C	80.5C
17	10:30	27	72.2C	76.7C	85.3C	81.4C
18	10:35	32	72.7C	77.1C	85.8C	81.9C
19	10:40	37	73.9C	77.4C	86.1C	82.3C
20	10:45	42	74.3C	77.5C	86.3C	82.6C
21	10:50	47	74.1C	77.2C	86.2C	82.2C
22	10:55	52	73.2C	76.7C	85.4C	81.6C
23	11: 0	57	74.1C	77.6C	86.5C	82.9C

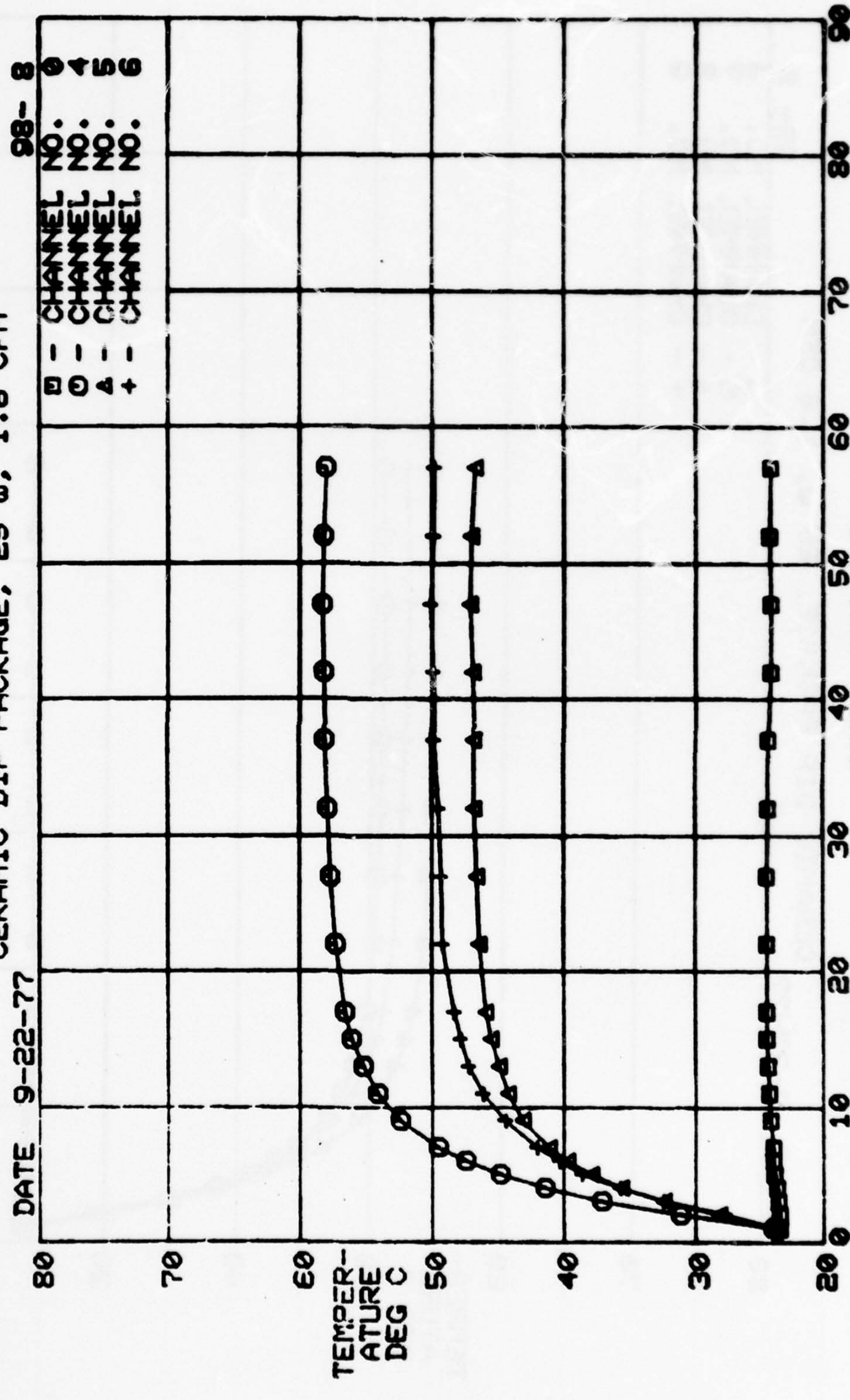
CERAMIC DIP PACKAGE, 50 W, 1.6 CFM

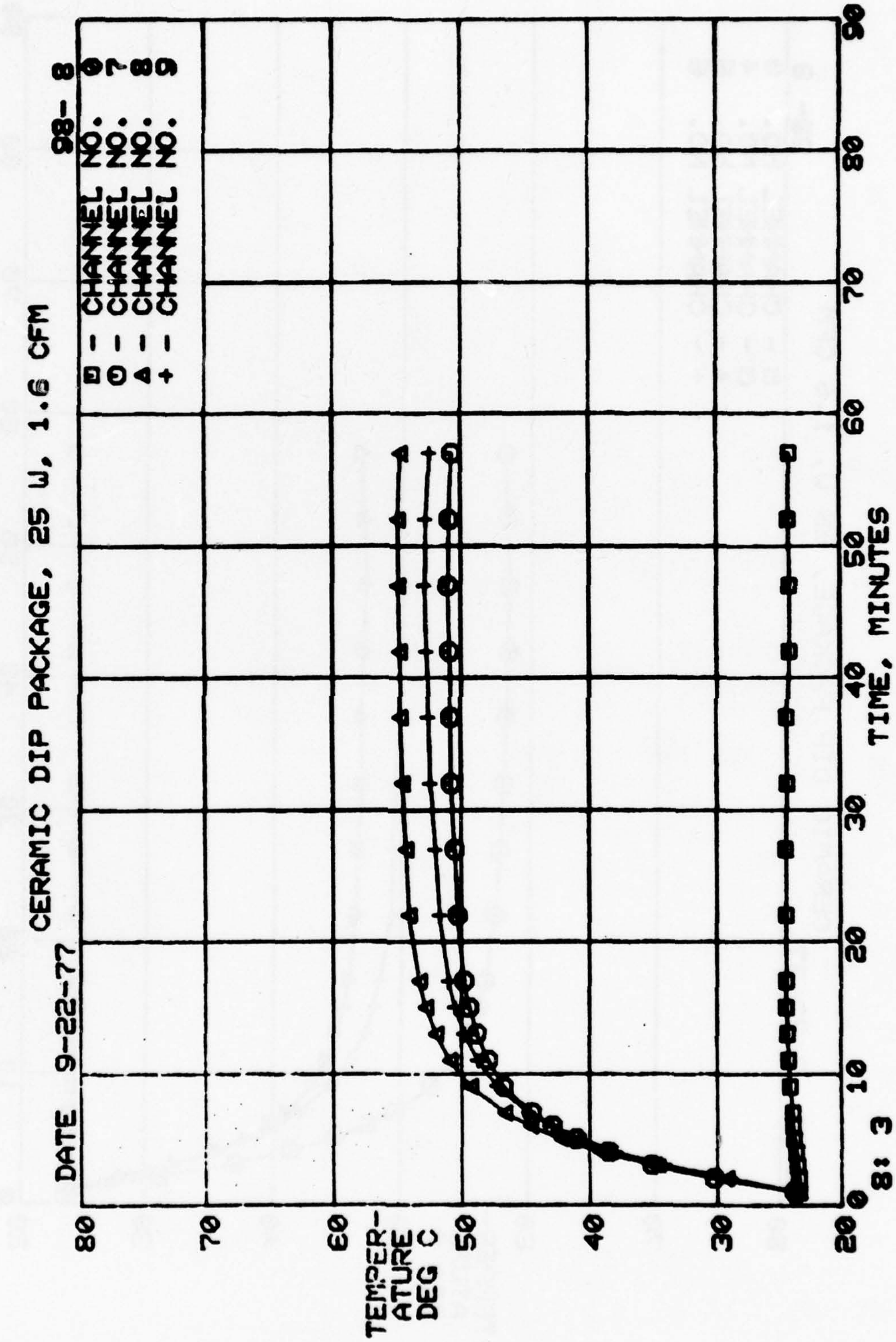
TEST STARTING DATE: 9-22-77 REQ. NO. 98 RUN NO. 9

CHAN. NO.	MIN. VALUE	MAX. VALUE	MAX. GRADIENT	BEGIN. ELAPSED TIME
0	22.4 C	25.3 C	.40 C/MIN	6 MIN
1	22.4 C	79.7 C	15.7 C/MIN	1 MIN
2	22.4 C	79.6 C	15.8 C/MIN	1 MIN
3	22.4 C	93.6 C	16.1 C/MIN	1 MIN
4	22.4 C	93.6 C	15. C/MIN	1 MIN
5	22.4 C	69.6 C	9. C/MIN	1 MIN
6	22.4 C	74.3 C	9.20 C/MIN	2 MIN
7	22.4 C	77.6 C	13.4 C/MIN	1 MIN
8	22.4 C	86.5 C	11.6 C/MIN	2 MIN
9	22.4 C	82.9 C	10.7 C/MIN	2 MIN



DATE 9-22-77
CERAMIC DIP PACKAGE, 25 W, 1.6 CFM
98- 8
□ - CHANNEL NO. 0
○ - CHANNEL NO. 1
△ - CHANNEL NO. 2
+ - CHANNEL NO. 3
TEMPER-
ATURE
DEG C
80
70
60
50
40
30
20
0
10
20
30
40
50
60
70
80
90
TIME, MINUTES
8: 3


DATE 9-22-77
CERAMIC DIP PACKAGE, 25 W, 1.6 CFM
98- 8
⊡ - CHANNEL NO. 3
⊙ - CHANNEL NO. 4
△ - CHANNEL NO. 5
+ - CHANNEL NO. 6
TEMPER-
ATURE
DEG C
80
70
60
50
40
30
20
0
10
20
30
40
50
60
70
80
90
TIME, MINUTES
8: 3


CERAMIC DIP PACKAGE, 25 W, 1.6 CFM
DATE 9-22-77
98- 8
□ - CHANNEL NO. 6
○ - CHANNEL NO. 7
△ - CHANNEL NO. 8
+ - CHANNEL NO. 9
TEMPER-
ATURE
DEG C
80
70
60
50
40
30
20
0
10
20
30
40
50
60
70
80
90
TIME, MINUTES
8: 3

CERAMIC DIP PACKAGE, 25 W, 1.6 CFM

TEST STARTING DATE: 9-22-77 REQ. NO. 98 RUN NO. 8

			CHANNEL NUMBER					
SCAN	HR:MN	ELAPSED TIME	0	1	2	3	4	5
1	8: 3	0	23.4C	23.8C	23.9C	23.9C	23.9C	23.8C
2	8: 4	1	23.4C	23.8C	23.8C	23.8C	23.9C	23.7C
3	8: 5	2	23.4C	31.3C	31.3C	31.5C	31.1C	28.1C
4	8: 6	3	23.5C	36.2C	36.4C	37.4C	37.1C	32.4C
5	8: 7	4	23.6C	39.4C	39.8C	41.7C	41.4C	35.6C
6	8: 8	5	23.8C	41.9C	42.2C	44.9C	44.8C	37.9C
7	8: 9	6	23.9C	43.7C	44.2C	47.4C	47.4C	39.7C
8	8:10	7	23.9C	45.4C	45.8C	49.6C	49.5C	41.1C
9	8:12	9	24.1C	47.6C	47.9C	52.4C	52.4C	43.1C
10	8:14	11	24.2C	48.7C	49. C	54.1C	54.1C	44.2C
11	8:16	13	24.3C	49.5C	49.9C	55.3C	55.2C	44.9C
12	8:18	15	24.4C	50.3C	50.5C	56.1C	56.1C	45.5C
13	8:20	17	24.4C	50.6C	50.9C	56.6C	56.6C	45.9C
14	8:25	22	24.4C	51.2C	51.4C	57.3C	57.3C	46.4C
15	8:30	27	24.4C	51.3C	51.6C	57.7C	57.7C	46.6C
16	8:35	32	24.3C	51.4C	51.8C	57.7C	57.9C	46.8C
17	8:40	37	24.3C	51.5C	51.8C	57.7C	58.1C	46.8C
18	8:45	42	24.1C	51.7C	51.9C	58.1C	58.2C	46.9C
19	8:50	47	24.1C	51.8C	52.1C	58.2C	58.3C	47.1C
20	8:55	52	24.2C	51.7C	51.9C	58.2C	58.2C	47. C
21	9: 0	57	24.1C	51.4C	51.7C	58. C	58. C	46.7C

CERAMIC DIP PACKAGE, 25 W, 1.6 CFM

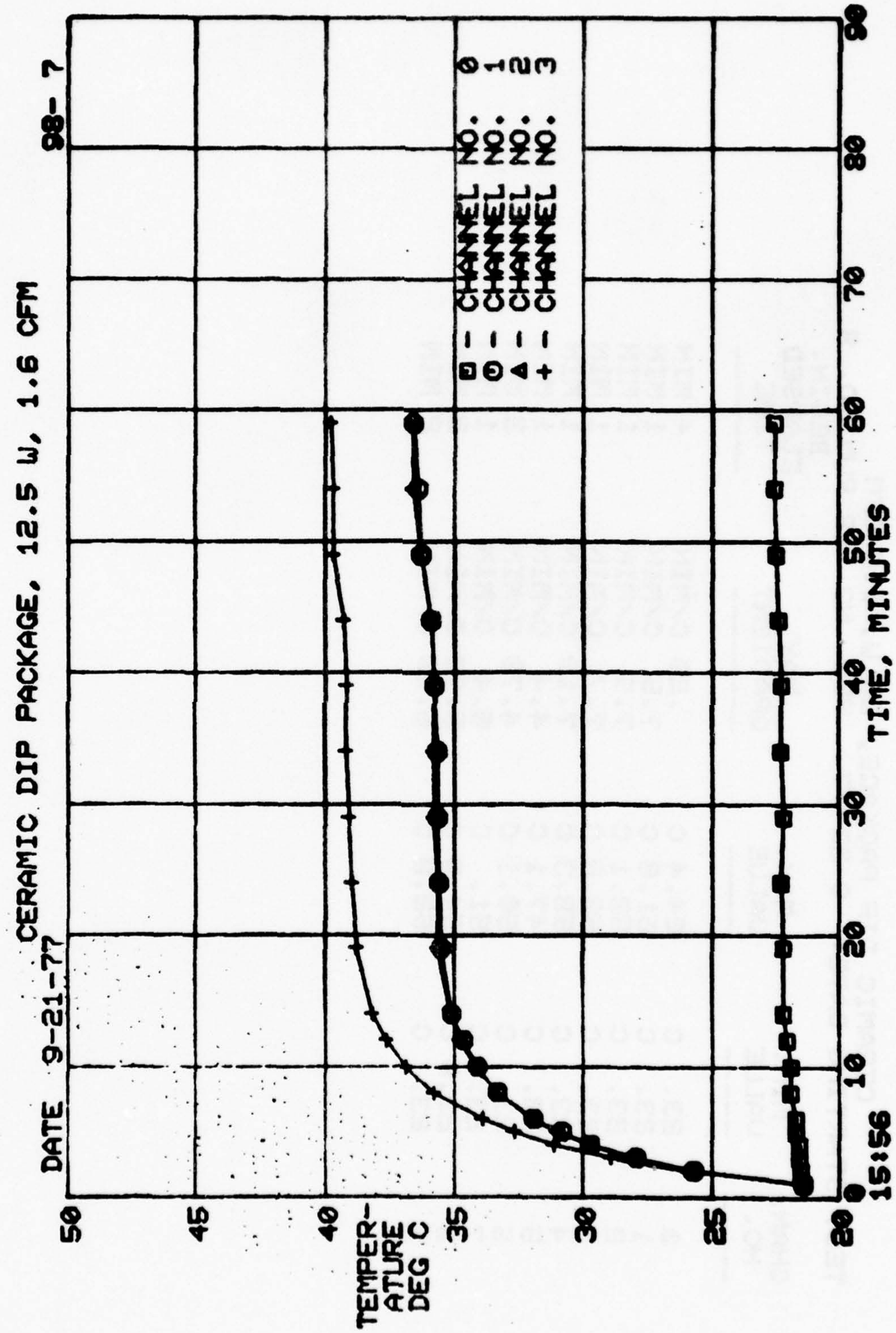
TEST STARTING DATE: 9-22-77 REQ. NO. 98 RUN NO. 8

		ELAPSED	CHANNEL NUMBER			
SCAN	HR:MN	TIME	6	7	8	9
1	8: 3	0	23.9C	23.9C	24. C	23.9C
2	8: 4	1	23.8C	23.8C	23.9C	23.8C
3	8: 5	2	27.7C	30.2C	29.2C	28.9C
4	8: 6	3	32.4C	35.1C	34.9C	34.1C
5	8: 7	4	35.7C	38.5C	39.1C	37.9C
6	8: 8	5	38.6C	41. C	42.2C	40.8C
7	8: 9	6	40.3C	42.9C	44.6C	42.9C
8	8:10	7	42. C	44.5C	46.6C	44.7C
9	8:12	9	44.4C	46.7C	49.3C	47.2C
10	8:14	11	46.1C	47.9C	50.9C	48.7C
11	8:16	13	47.2C	48.8C	52. C	49.8C
12	8:18	15	47.8C	49.4C	52.8C	50.5C
13	8:20	17	48.3C	49.8C	53.3C	51. C
14	8:25	22	49.2C	50.3C	54.1C	51.7C
15	8:30	27	49.3C	50.5C	54.3C	52. C
16	8:35	32	49.5C	50.8C	54.6C	52.4C
17	8:40	37	49.8C	50.8C	54.7C	52.5C
18	8:45	42	49.9C	50.9C	54.8C	52.7C
19	8:50	47	50.1C	51. C	54.9C	52.8C
20	8:55	52	49.9C	50.9C	54.9C	52.7C
21	9: 0	57	49.8C	50.7C	54.7C	52.4C

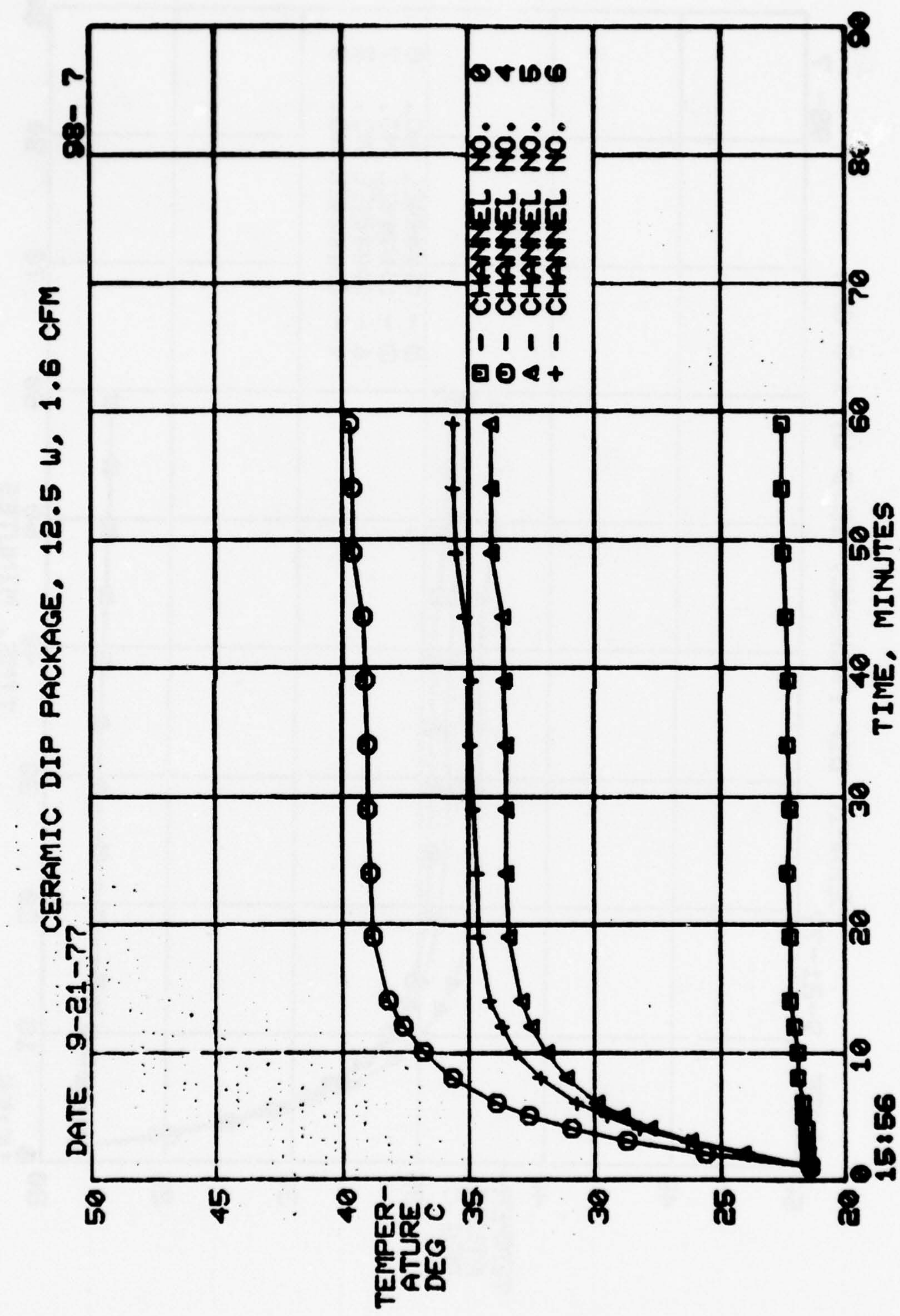
CERAMIC DIP PACKAGE, 25 W, 1.6 CFM

TEST STARTING DATE: 9-22-77 REQ. NO. 98 RUN NO. 8

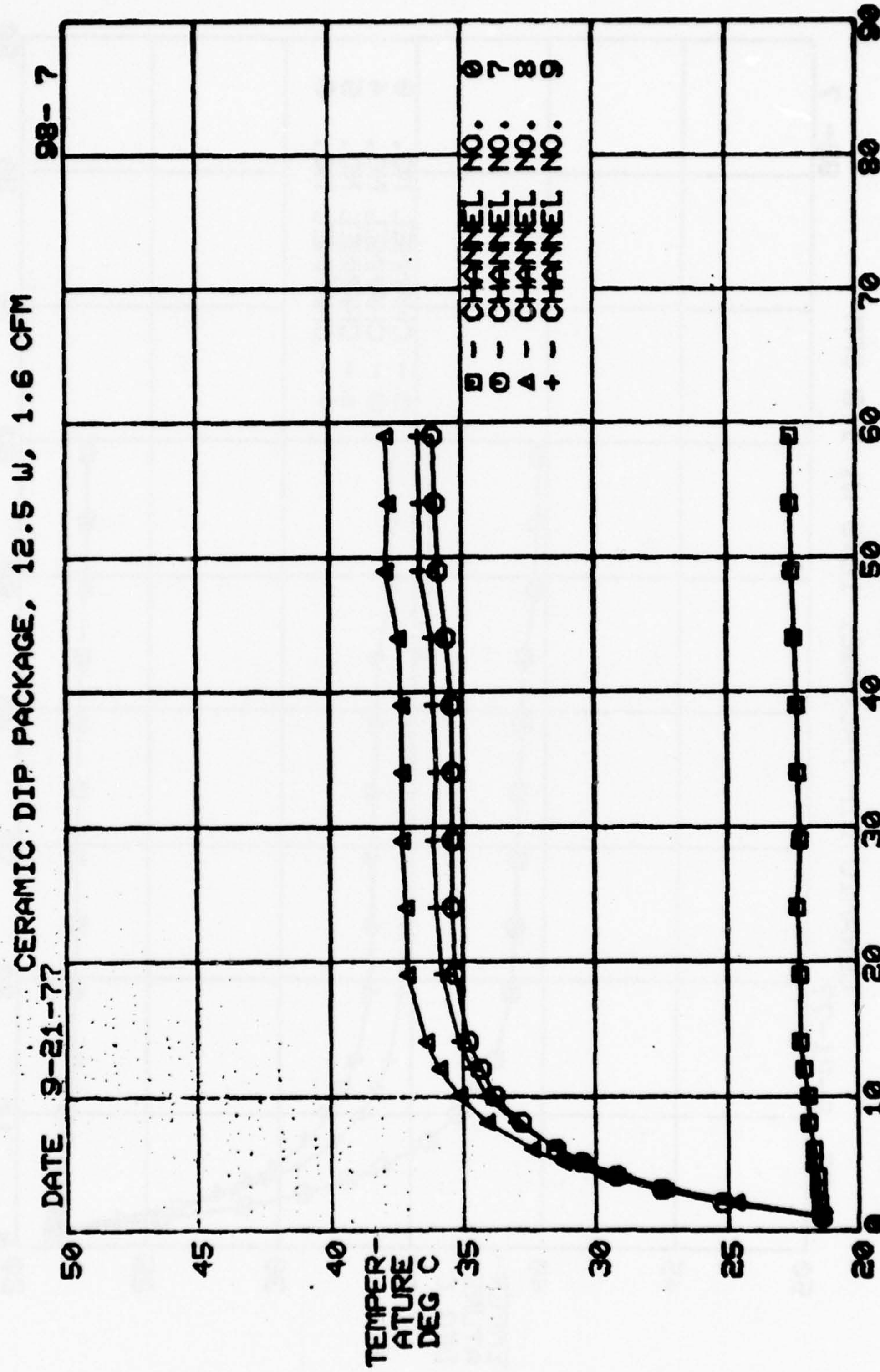
CHAN. NO.	MIN. VALUE	MAX. VALUE	MAX. GRADIENT	BEGIN. ELAPSED TIME
0	23. C	24.4 C	.20 C/MIN	4 MIN
1	23. C	51.8 C	7.5 C/MIN	1 MIN
2	23. C	52.1 C	7.5 C/MIN	1 MIN
3	23. C	58.2 C	7.7 C/MIN	1 MIN
4	23. C	58.3 C	7.19 C/MIN	1 MIN
5	23. C	47.1 C	4.4 C/MIN	1 MIN
6	23. C	50.1 C	4.70 C/MIN	2 MIN
7	23. C	51. C	6.4 C/MIN	1 MIN
8	23.9 C	54.9 C	5.70 C/MIN	2 MIN
9	23. C	52.8 C	5.19 C/MIN	2 MIN



DATE 9-21-77
CERAMIC DIP PACKAGE, 12.5 W, 1.6 CFM
98- 7
TEMPER-
ATURE
DEG C
TIME, MINUTES
15:56
□ -- CHANNEL NO. 0
⊙ -- CHANNEL NO. 1
△ -- CHANNEL NO. 2
+ -- CHANNEL NO. 3
50
45
40
35
30
25
20
0
10
20
30
40
50
60
70
80
90



DATE 9-21-77
CERAMIC DIP PACKAGE, 12.5 W, 1.6 CFM
98- 7
□ — CHANNEL NO. 3
⊙ — CHANNEL NO. 4
△ — CHANNEL NO. 5
+ — CHANNEL NO. 6
TEMPER-
ATURE
DEG C
50
45
40
35
30
25
20
0
10
20
30
40
50
60
70
80
90
15:56
TIME, MINUTES



DATE 9-21-77
CERAMIC DIP PACKAGE, 12.5 W, 1.6 CFM
98- 7
TEMPER-
ATURE
DEG C
50
45
40
35
30
25
20
0
10
20
30
40
50
60
70
80
90
15:56
TIME, MINUTES
□ - CHANNEL NO. 6
⊙ - CHANNEL NO. 7
△ - CHANNEL NO. 8
+ - CHANNEL NO. 9

CERAMIC DIP PACKAGE, 12.5 W, 1.6 CFM

TEST STARTING DATE: 9-21-77 REQ. NO. 98 RUN NO. 7

CHANNEL NUMBER

SCAN	HR:MN	ELAPSED TIME	0	1	2	3	4	5
1	15:56	0	21.4C	21.4C	21.4C	21.4C	21.4C	21.4C
2	15:57	1	21.4C	21.4C	21.4C	21.4C	21.4C	21.4C
3	15:58	2	21.5C	25.7C	25.7C	25.9C	25.6C	24.1C
4	15:59	3	21.6C	27.9C	28.1C	28.9C	28.7C	26.2C
5	16: 0	4	21.6C	29.7C	29.7C	31.1C	30.9C	27.8C
6	16: 1	5	21.7C	30.8C	31. C	32.7C	32.6C	28.9C
7	16: 2	6	21.7C	31.9C	32. C	33.9C	33.9C	29.9C
8	16: 4	8	21.9C	33.3C	33.3C	35.8C	35.7C	31.1C
9	16: 6	10	21.9C	34.1C	34.2C	36.9C	36.8C	31.9C
10	16: 8	12	22.1C	34.7C	34.8C	37.7C	37.6C	32.5C
11	16:10	14	22.2C	35.1C	35.2C	38.2C	38.2C	32.9C
12	16:15	19	22.2C	35.5C	35.7C	38.8C	38.8C	33.4C
13	16:20	24	22.3C	35.6C	35.7C	39. C	38.9C	33.5C
14	16:25	29	22.2C	35.7C	35.8C	39.1C	39. C	33.5C
15	16:30	34	22.3C	35.7C	35.8C	39.2C	39. C	33.5C
16	16:35	39	22.3C	35.8C	35.8C	39.2C	39.1C	33.6C
17	16:40	44	22.4C	35.9C	35.9C	39.3C	39.2C	33.7C
18	16:45	49	22.5C	36.3C	36.3C	39.7C	39.6C	34.1C
19	16:50	54	22.6C	36.4C	36.6C	39.7C	39.6C	34.1C
20	16:55	59	22.6C	36.6C	36.7C	39.8C	39.7C	34.1C

CERAMIC DIP PACKAGE, 12.5 W, 1.6 CFM

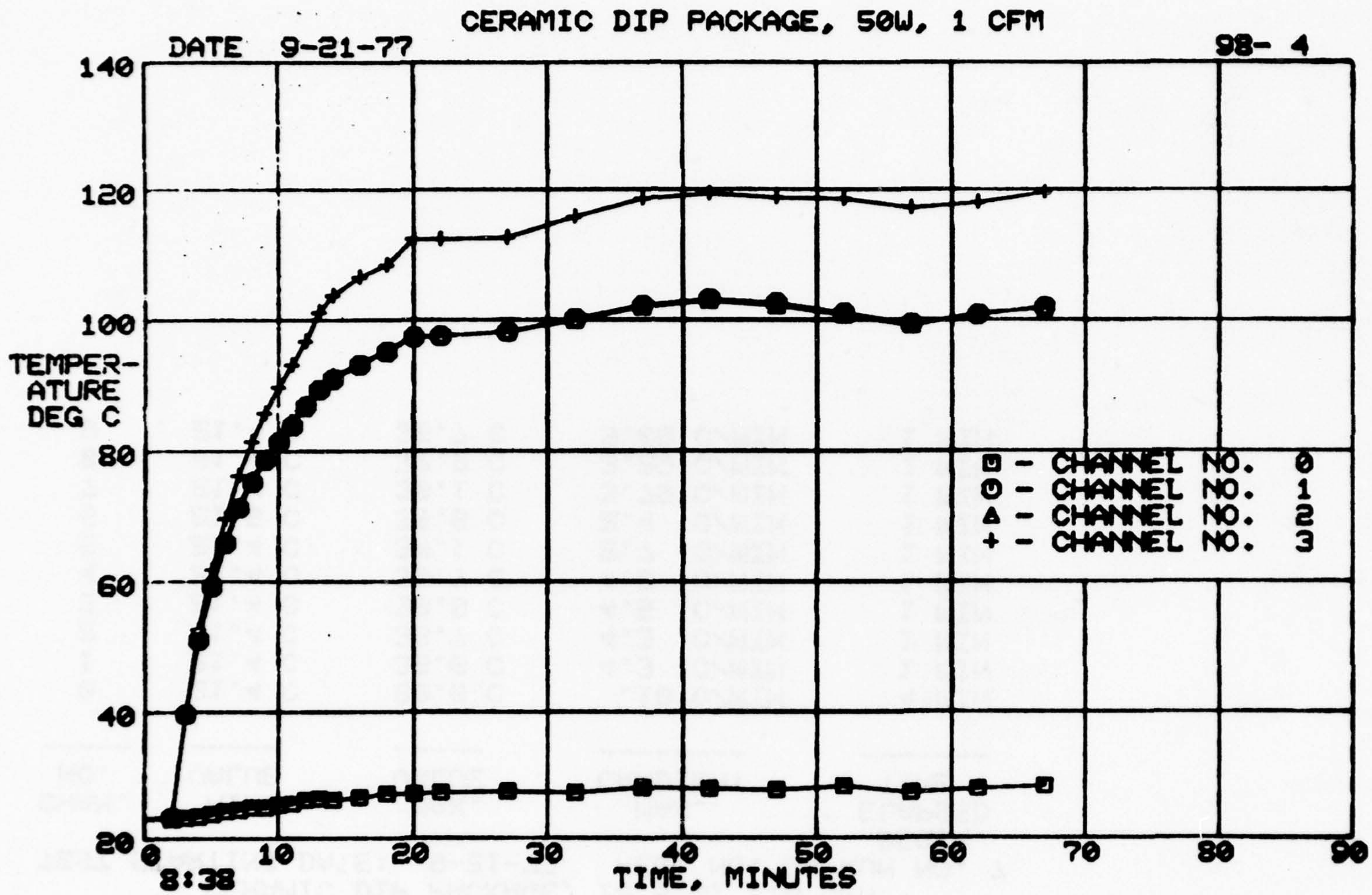
TEST STARTING DATE: 9-21-77 REQ. NO. 98 RUN NO. 7

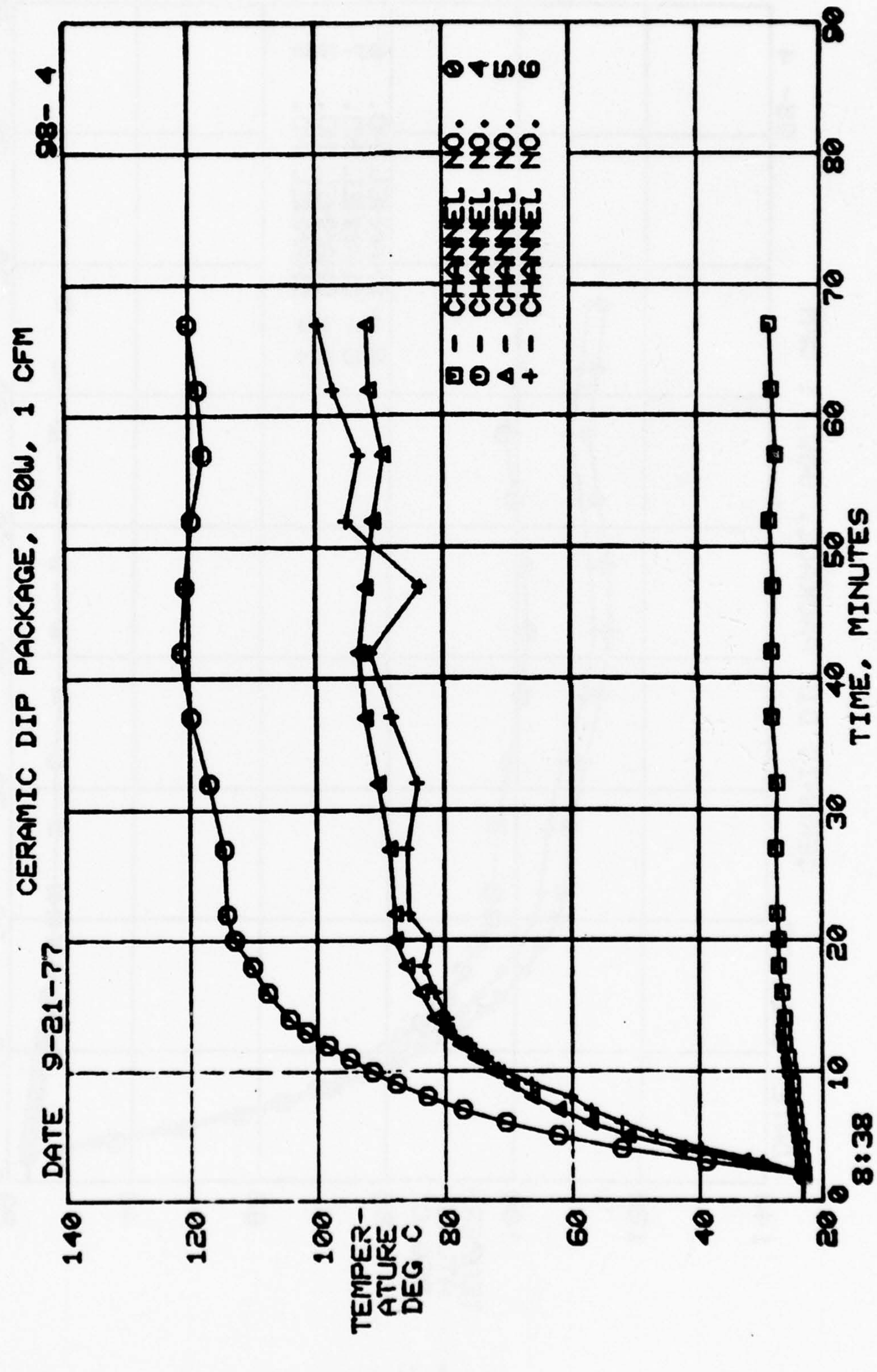
SCAN	HR:MN	ELAPSED TIME	CHANNEL NUMBER 6	7	8	9
1	15:56	0	21.5C	21.4C	21.4C	21.4C
2	15:57	1	21.5C	21.4C	21.4C	21.4C
3	15:58	2	23.9C	25.2C	24.7C	24.5C
4	15:59	3	26.3C	27.5C	27.5C	27.1C
5	16: 0	4	28.2C	29.2C	29.6C	28.9C
6	16: 1	5	29.5C	30.5C	31.2C	30.4C
7	16: 2	6	30.7C	31.5C	32.4C	31.4C
8	16: 4	8	32.2C	32.8C	34.1C	33. C
9	16: 6	10	33.2C	33.8C	35.2C	34.1C
10	16: 8	12	33.7C	34.3C	35.9C	34.7C
11	16:10	14	34.2C	34.8C	36.4C	35.2C
12	16:15	19	34.6C	35.3C	37.1C	35.8C
13	16:20	24	34.7C	35.4C	37.2C	36. C
14	16:25	29	34.8C	35.4C	37.3C	36.1C
15	16:30	34	34.9C	35.4C	37.3C	36. C
16	16:35	39	34.9C	35.4C	37.3C	36.1C
17	16:40	44	35.2C	35.6C	37.4C	36.2C
18	16:45	49	35.5C	35.9C	37.9C	36.6C
19	16:50	54	35.6C	36. C	37.8C	36.6C
20	16:55	59	35.6C	36.1C	37.9C	36.7C

CERAMIC DIP PACKAGE, 12.5 W, 1.6 CFM

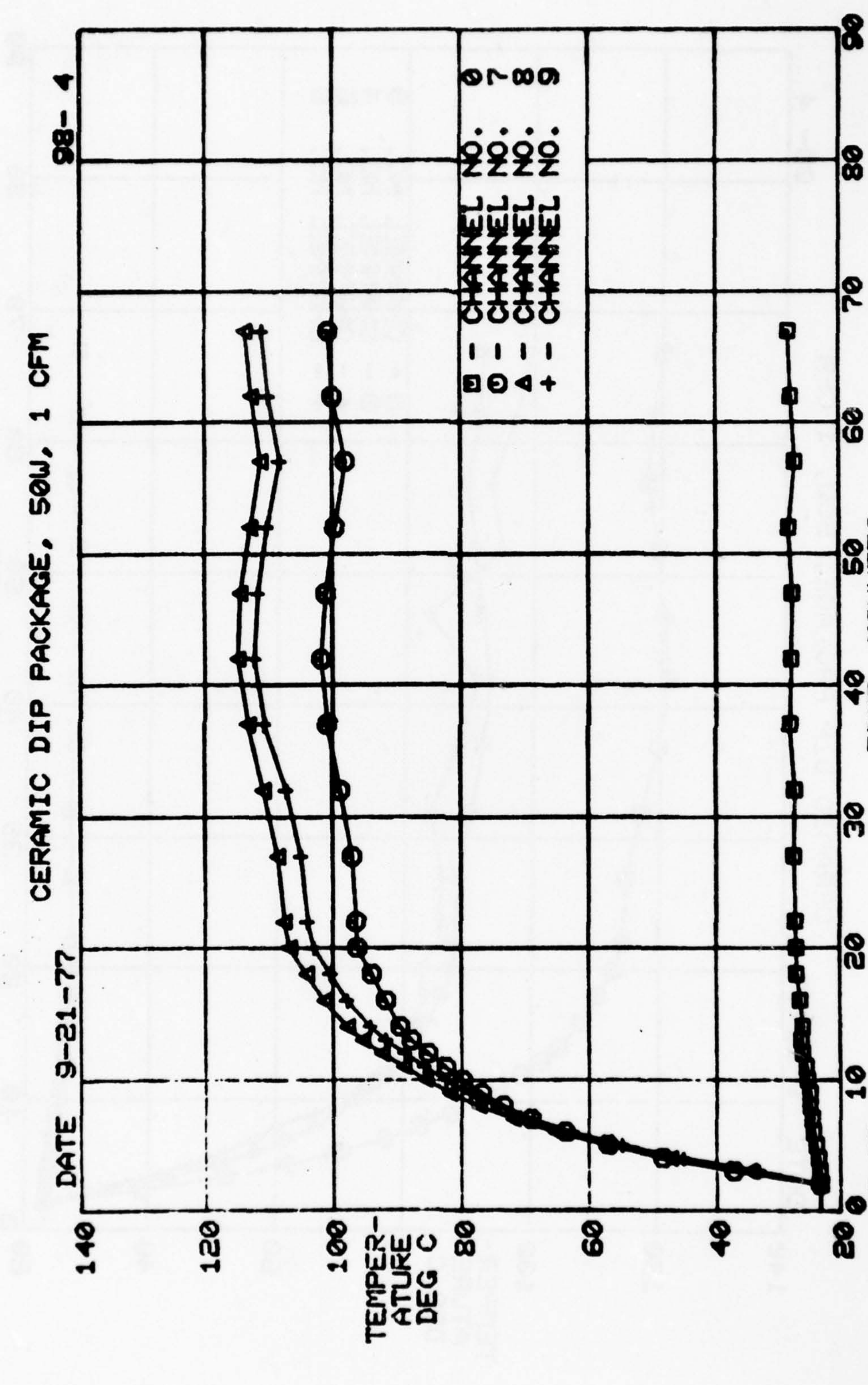
TEST STARTING DATE: 9-21-77 REQ. NO. 98 RUN NO. 7

CHAN. NO.	MIN. VALUE	MAX. VALUE	MAX. GRADIENT	BEGIN. ELAPSED TIME
0	21.4 C	22.6 C	.10 C/MIN	4 MIN
1	21.4 C	36.6 C	4.3 C/MIN	1 MIN
2	21.4 C	36.7 C	4.3 C/MIN	1 MIN
3	21.4 C	39.8 C	4.5 C/MIN	1 MIN
4	21.4 C	39.7 C	4.2 C/MIN	1 MIN
5	21.4 C	34.1 C	2.7 C/MIN	1 MIN
6	21.5 C	35.6 C	2.4 C/MIN	1 MIN
7	21.4 C	36.1 C	3.79 C/MIN	1 MIN
8	21.4 C	37.9 C	3.29 C/MIN	1 MIN
9	21.4 C	36.7 C	3.09 C/MIN	1 MIN


CERAMIC DIP PACKAGE, 50W, 1 CFM
DATE 9-21-77
98- 4
140
120
100
80
60
40
20
TEMPER-
ATURE
DEG C
0
10
20
30
40
50
60
70
80
90
8:38
TIME, MINUTES
□ - CHANNEL NO. 0
○ - CHANNEL NO. 1
△ - CHANNEL NO. 2
+ - CHANNEL NO. 3



CERAMIC DIP PACKAGE, 50W, 1 CFM
DATE 9-21-77
98- 4
□ — CHANNEL NO. 0
⊙ — CHANNEL NO. 4
△ — CHANNEL NO. 5
+ — CHANNEL NO. 6
TEMPER-
ATURE
DEG C
140
120
100
80
60
40
20
0
10
20
30
40
50
60
70
80
90
8:38
TIME, MINUTES



DATE 9-21-77
CERAMIC DIP PACKAGE, 50W, 1 CFM
98- 4
TEMPER-
ATURE
DEG C
140
120
100
80
60
40
20
0
10
20
30
40
50
60
70
80
90
8:38
TIME, MINUTES
□ - CHANNEL NO. 6
⊙ - CHANNEL NO. 7
△ - CHANNEL NO. 8
+ - CHANNEL NO. 9

CERAMIC DIP PACKAGE, 50W, 1 CFM

TEST STARTING DATE: 9-21-77 REQ. NO. 98 RUN NO. 4

			CHANNEL NUMBER					
SCAN	HR:MN	ELAPSED TIME	0	1	2	3	4	5
1	8:38	0	23.2C	23.2C	23.2C	23.3C	23.3C	23.2C
2	8:40	2	23.1C	23.2C	23.2C	23.2C	23.2C	23.2C
3	8:41	3	23.2C	39.7C	39.6C	39.9C	38.9C	33. C
4	8:42	4	23.4C	51.1C	51.4C	52.7C	52.3C	43.3C
5	8:43	5	23.8C	59.3C	59.7C	61.9C	62.2C	51.2C
6	8:44	6	24.3C	65.9C	66.3C	69.7C	70.5C	57.3C
7	8:45	7	24.5C	71.2C	71.6C	76.3C	77.3C	62.3C
8	8:46	8	24.9C	75.2C	75.7C	81.5C	82.8C	66.4C
9	8:47	9	24.9C	78.7C	79.1C	85.9C	87.6C	69.7C
10	8:48	10	25.3C	81.4C	81.8C	89.8C	91.5C	72.7C
11	8:49	11	25.4C	83.9C	84.4C	93.3C	95.1C	75.2C
12	8:50	12	26.1C	86.8C	87.2C	96.8C	98.5C	77.6C
13	8:51	13	26.2C	89.4C	89.7C	101.2C	101.8C	79.9C
14	8:52	14	26.1C	91.1C	91.4C	103.8C	104.4C	81.7C
15	8:54	16	26.4C	93.3C	93.4C	106.7C	107.8C	83.9C
16	8:56	18	27. C	95.2C	95.4C	108.4C	110.3C	86. C
17	8:58	20	27. C	97.5C	97.6C	112.5C	113. C	87.8C
18	9: 0	22	27.2C	97.7C	97.7C	112.4C	114.2C	87.9C
19	9: 5	27	27.5C	98.2C	98.2C	112.6C	114.6C	88.7C
20	9:10	32	27.3C	100.2C	100.1C	115.8C	117.1C	90.5C
21	9:15	37	28. C	102.3C	102.1C	118.6C	119.8C	92.4C
22	9:20	42	27.8C	103.3C	103.1C	119.5C	121.2C	93.2C
23	9:25	47	27.6C	102.6C	102.2C	118.8C	120.6C	92.2C
24	9:30	52	28.2C	101.1C	100.9C	118.6C	119.6C	91.1C
25	9:35	57	27.2C	99.4C	99.3C	117.3C	117.9C	89.4C
26	9:40	62	27.9C	100.9C	101.1C	118.1C	118.6C	91.7C
27	9:45	67	28.3C	102.1C	101.8C	119.7C	120.3C	92.1C

CERAMIC DIP PACKAGE, 50W, 1 CFM

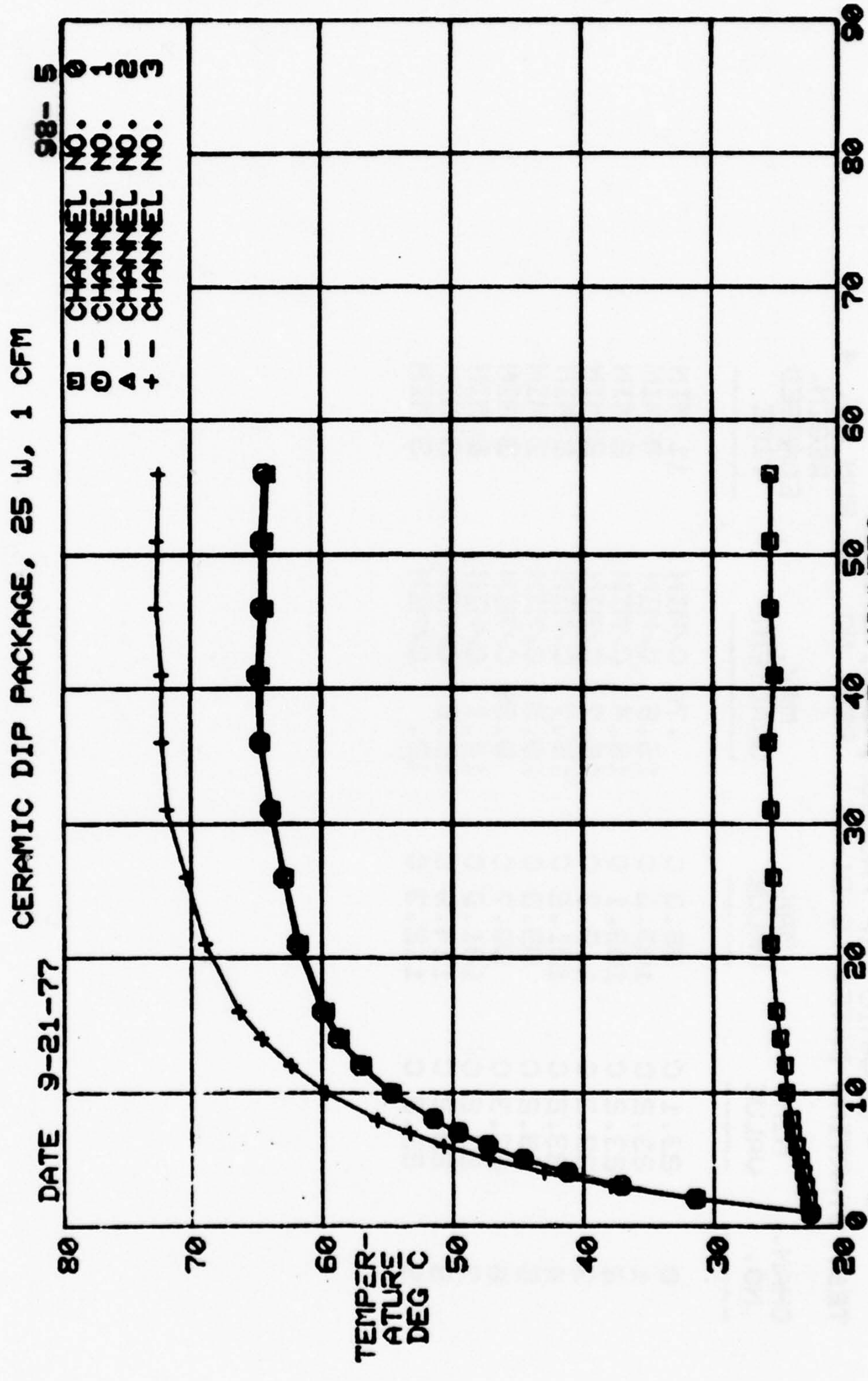
TEST STARTING DATE: 9-21-77 REQ. NO. 98 RUN NO. 4

SCAN	HR:MN	ELAPSED TIME	CHANNEL NUMBER 6	7	8	9
1	8:38	0	23.3C	23.2C	23.3C	23.3C
2	8:40	2	23.3C	23.2C	23.2C	23.2C
3	8:41	3	29.9C	37.3C	34.7C	33.3C
4	8:42	4	39.7C	48.5C	47.3C	45.3C
5	8:43	5	46.8C	57. C	57.2C	54.9C
6	8:44	6	52.2C	63.6C	65.2C	62.6C
7	8:45	7	57.1C	69.1C	71.9C	68.9C
8	8:46	8	60.3C	73.4C	77.3C	74.3C
9	8:47	9	66.4C	76.9C	81.8C	78.6C
10	8:48	10	70.8C	79.8C	85.7C	82.4C
11	8:49	11	73.5C	82.5C	89.1C	85.8C
12	8:50	12	76.1C	85.3C	92.4C	88.9C
13	8:51	13	79.3C	87.8C	95.4C	91.8C
14	8:52	14	79.7C	89.6C	97.9C	94.3C
15	8:54	16	81.7C	91.9C	101.4C	97.8C
16	8:56	18	83.3C	94.1C	104.2C	100.4C
17	8:58	20	82.4C	96.2C	106.8C	103.1C
18	9: 0	22	85.6C	96.4C	107.7C	104. C
19	9: 5	27	85.9C	97. C	108.6C	105. C
20	9:10	32	84.2C	98.9C	110.9C	107.3C
21	9:15	37	88.2C	100.9C	113.3C	110.7C
22	9:20	42	91.5C	101.9C	114.9C	112.3C
23	9:25	47	83.7C	101. C	114.4C	111.7C
24	9:30	52	95.3C	99.7C	112.8C	110.2C
25	9:35	57	93.3C	98.1C	111.2C	108.3C
26	9:40	62	97.2C	100. C	112.6C	110. C
27	9:45	67	99.7C	100.7C	113.7C	111. C

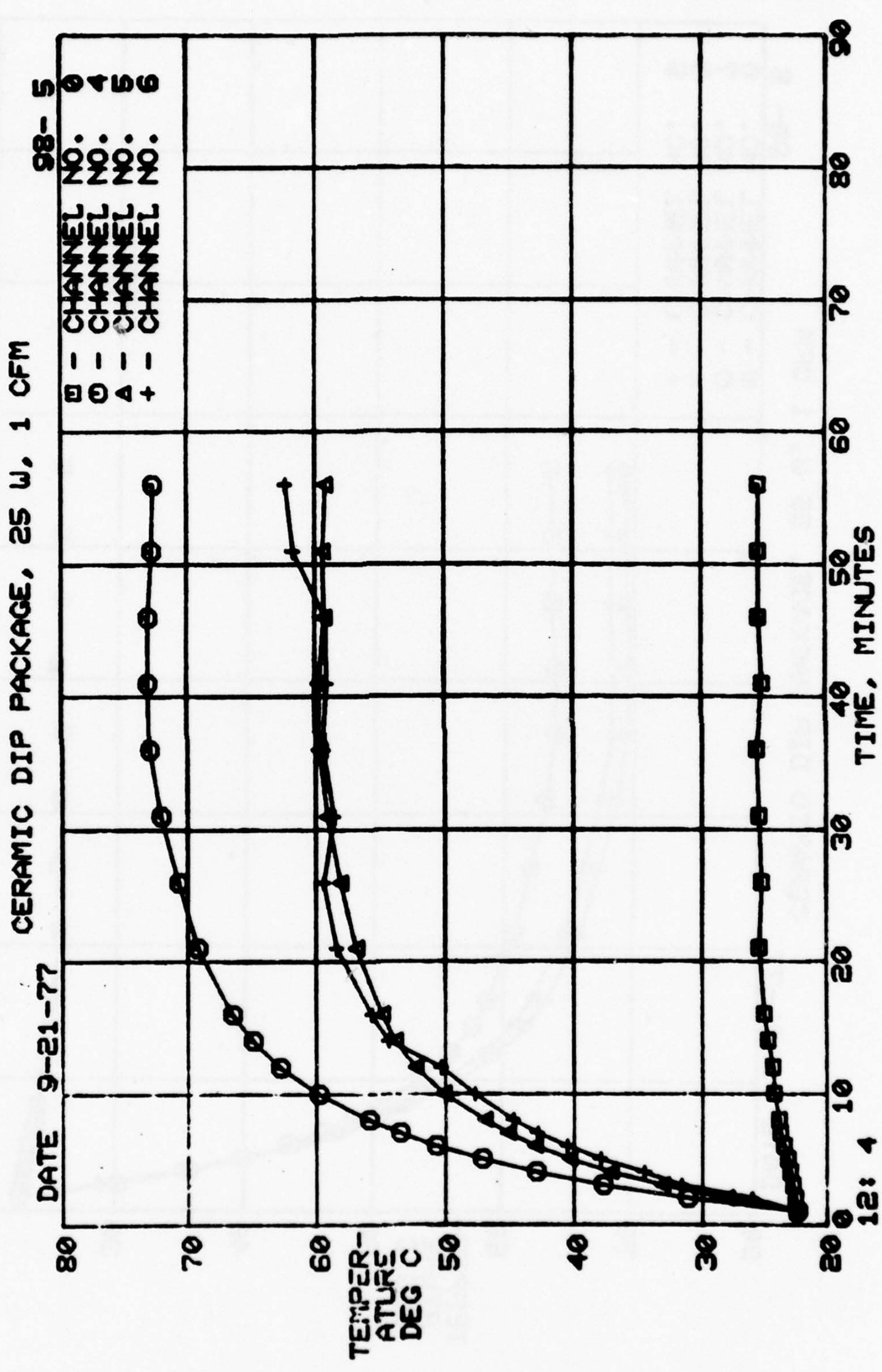
CERAMIC DIP PACKAGE, 50W, 1 CFM

TEST STARTING DATE: 9-21-77 REQ. NO. 98 RUN NO. 4

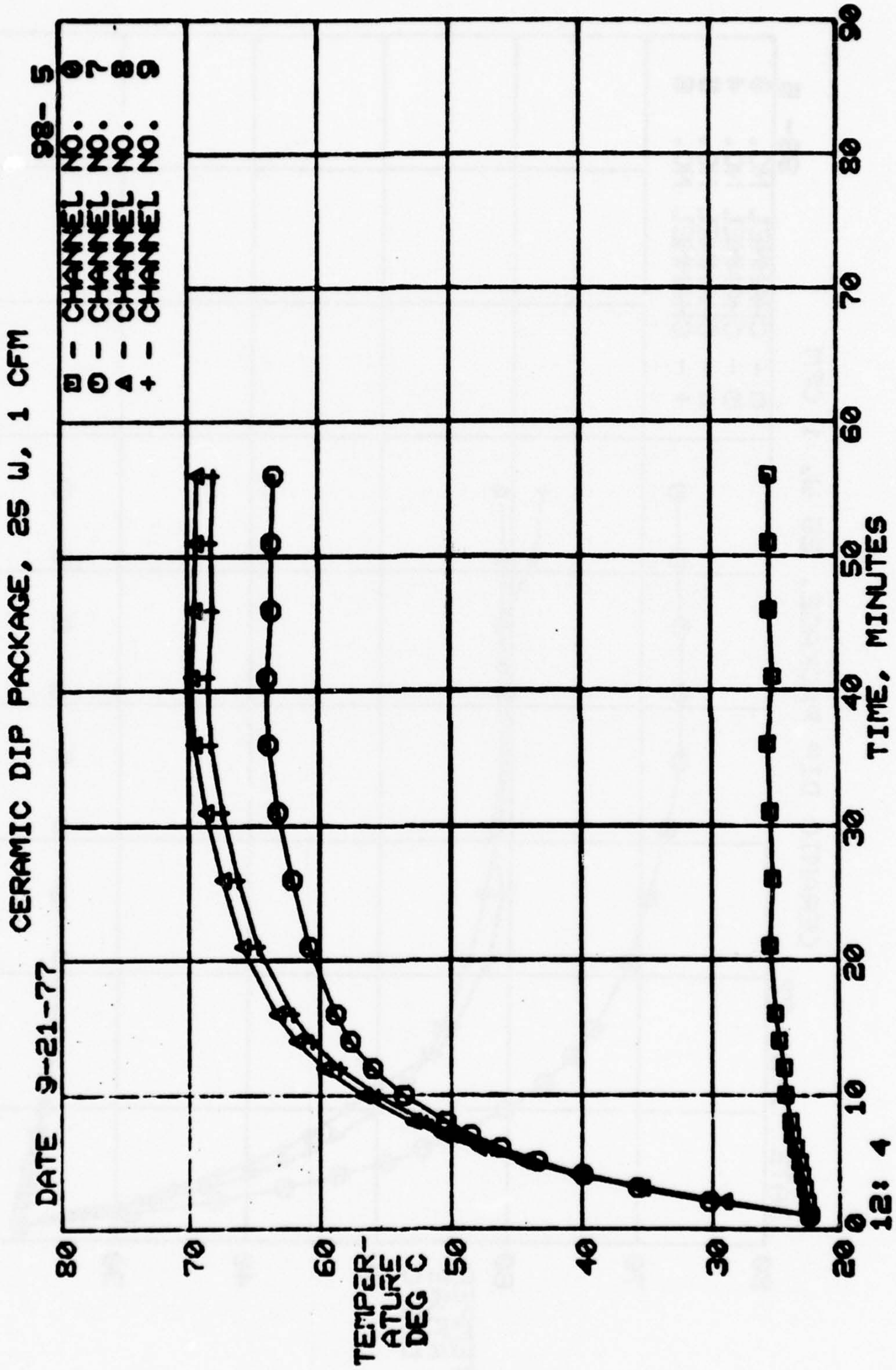
CHAN. NO.	MIN. VALUE	MAX. VALUE	MAX. GRADIENT	BEGIN. ELAPSED TIME
0	23.1 C	28.3 C	.70 C/MIN	11 MIN
1	23.2 C	103.3 C	16.5 C/MIN	2 MIN
2	23.2 C	103.1 C	16.4 C/MIN	2 MIN
3	23.2 C	119.7 C	16.7 C/MIN	2 MIN
4	23.2 C	121.2 C	15.7 C/MIN	2 MIN
5	23.2 C	93.2 C	10.3 C/MIN	3 MIN
6	23.3 C	99.7 C	9.80 C/MIN	3 MIN
7	23.2 C	101.9 C	14.1 C/MIN	2 MIN
8	23.2 C	114.9 C	12.6 C/MIN	3 MIN
9	23.2 C	112.3 C	12. C/MIN	3 MIN



CERAMIC DIP PACKAGE, 25 W, 1 CFM
DATE 9-21-77
98- 5
□ - CHANNEL NO. 0
⊙ - CHANNEL NO. 1
△ - CHANNEL NO. 2
+ - CHANNEL NO. 3
TEMPER-
ATURE
DEG C
20
30
40
50
60
70
80
0
10
20
30
40
50
60
70
80
90
12: 4
TIME, MINUTES



DATE 9-21-77
CERAMIC DIP PACKAGE, 25 W, 1 CFM
98- 5
□ - CHANNEL NO. 3
⊙ - CHANNEL NO. 4
△ - CHANNEL NO. 5
+ - CHANNEL NO. 6
TEMPER-
ATURE
DEG C
80
70
60
50
40
30
20
12: 4
0
10
20
30
40
50
60
70
80
90
TIME, MINUTES


DATE 9-21-77
CERAMIC DIP PACKAGE, 25 W, 1 CFM
98- 5
⊠ - CHANNEL NO. 6
⊙ - CHANNEL NO. 7
△ - CHANNEL NO. 8
+ - CHANNEL NO. 9
TEMPER-
ATURE
DEG C
20
30
40
50
60
70
80
0
10
20
30
40
50
60
70
80
90
12: 4
TIME, MINUTES

CERAMIC DIP PACKAGE, 25 W, 1 CFM

TEST STARTING DATE: 9-21-77 REQ. NO. 98 RUN NO. 5

		ELAPSED	CHANNEL NUMBER					
SCAN	HR:MN	TIME	0	1	2	3	4	5
1	12: 4	0	22.4C	22.3C	22.3C	22.3C	22.3C	22.3C
2	12: 5	1	22.4C	22.3C	22.3C	22.3C	22.3C	22.3C
3	12: 6	2	22.5C	31.4C	31.3C	31.5C	31.1C	28. C
4	12: 7	3	22.7C	37.1C	37.1C	37.9C	37.7C	33.1C
5	12: 8	4	22.9C	41.2C	41.2C	43. C	42.9C	37.1C
6	12: 9	5	23.1C	44.6C	44.7C	47.2C	47.1C	40.3C
7	12:10	6	23.4C	47.3C	47.4C	50.7C	50.7C	43. C
8	12:11	7	23.7C	49.6C	49.6C	53.3C	53.5C	45.1C
9	12:12	8	23.8C	51.5C	51.5C	55.8C	55.9C	46.9C
10	12:14	10	24.2C	54.7C	54.6C	59.7C	59.8C	50.1C
11	12:16	12	24.3C	57.1C	56.9C	62.4C	62.8C	52.3C
12	12:18	14	24.7C	58.8C	58.6C	64.6C	64.9C	53.9C
13	12:20	16	25. C	60. C	59.7C	66.3C	66.5C	54.9C
14	12:25	21	25.4C	61.9C	61.7C	68.9C	69.2C	56.9C
15	12:30	26	25.2C	62.9C	62.8C	70.4C	70.7C	58.1C
16	12:35	31	25.4C	63.9C	63.8C	71.9C	72.1C	59.1C
17	12:40	36	25.6C	64.7C	64.6C	72.3C	73. C	59.7C
18	12:45	41	25.1C	64.9C	64.6C	72.3C	73.1C	59.7C
19	12:50	46	25.4C	64.6C	64.3C	72.7C	73.1C	59.3C
20	12:55	51	25.4C	64.6C	64.3C	72.6C	72.8C	59.4C
21	13: 0	56	25.4C	64.4C	64.1C	72.5C	72.7C	59.2C

CERAMIC DIP PACKAGE, 25 W, 1 CFM

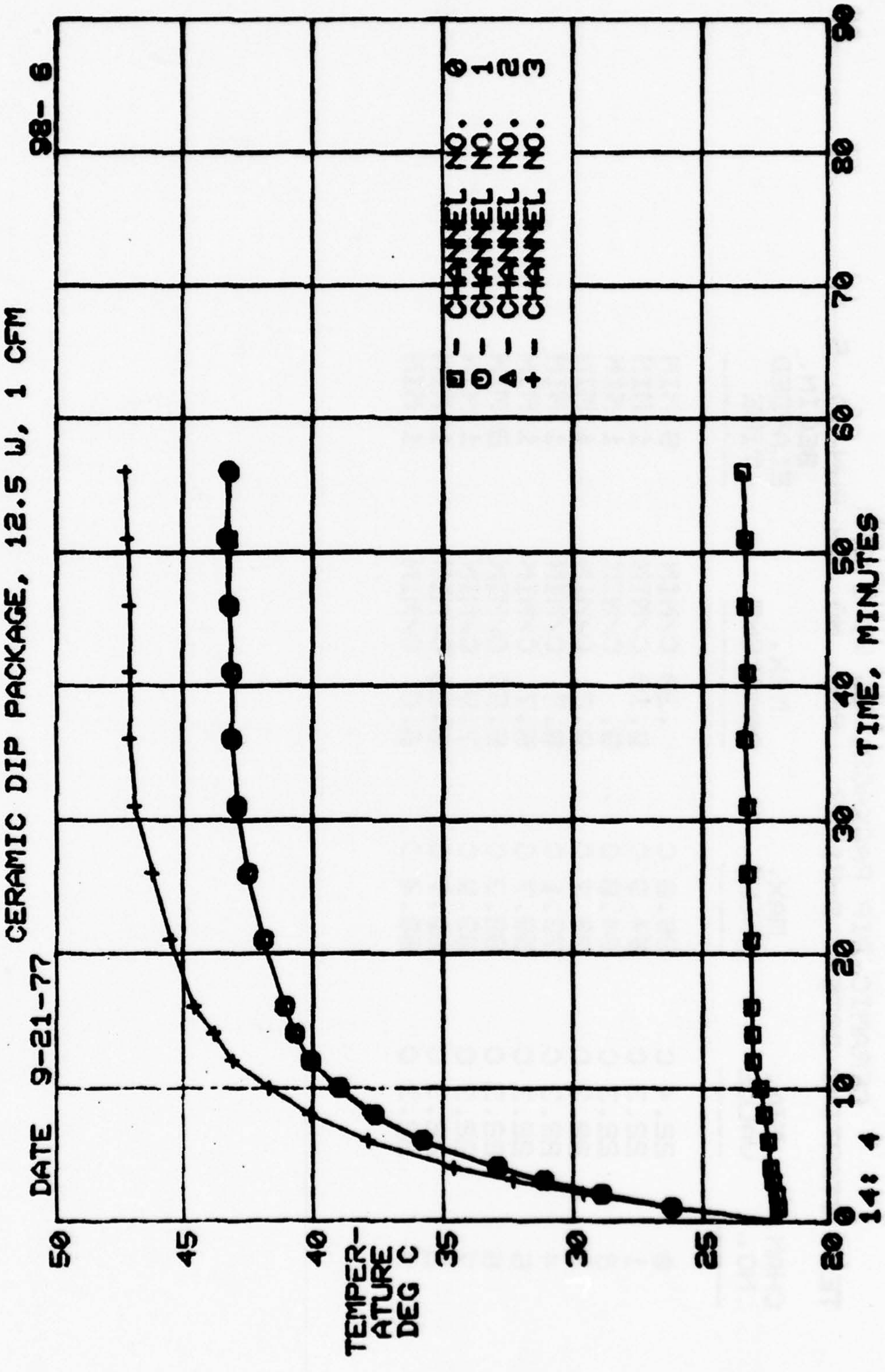
TEST STARTING DATE: 9-21-77 REQ. NO. 98 RUN NO. 5

			CHANNEL NUMBER			
SCAN	HR:MN	ELAPSED TIME	6	7	8	9
1	12: 4	0	22.3C	22.3C	22.3C	22.3C
2	12: 5	1	22.3C	22.3C	22.3C	22.3C
3	12: 6	2	26. C	30.2C	29.1C	28.9C
4	12: 7	3	31.6C	35.7C	35.4C	34.9C
5	12: 8	4	34.5C	39.9C	40.4C	39.7C
6	12: 9	5	37.9C	43.4C	44.5C	43.7C
7	12:10	6	40.5C	46.2C	47.9C	46.9C
8	12:11	7	42.8C	48.5C	50.7C	49.6C
9	12:12	8	44.7C	50.4C	52.9C	51.9C
10	12:14	10	47.7C	53.6C	56.7C	55.6C
11	12:16	12	50.3C	56. C	59.7C	58.5C
12	12:18	14	54.4C	57.7C	61.8C	60.6C
13	12:20	16	55.7C	58.8C	63.3C	62.1C
14	12:25	21	58.4C	60.8C	65.9C	64.7C
15	12:30	26	59.4C	62.1C	67.4C	66.2C
16	12:35	31	58.6C	63.2C	68.7C	67.4C
17	12:40	36	59.4C	63.9C	69.6C	68.3C
18	12:45	41	59.1C	63.9C	69.7C	68.4C
19	12:50	46	59.2C	63.6C	69.5C	68.1C
20	12:55	51	61.7C	63.6C	69.4C	68.2C
21	13: 0	56	62.3C	63.4C	69.3C	68. C

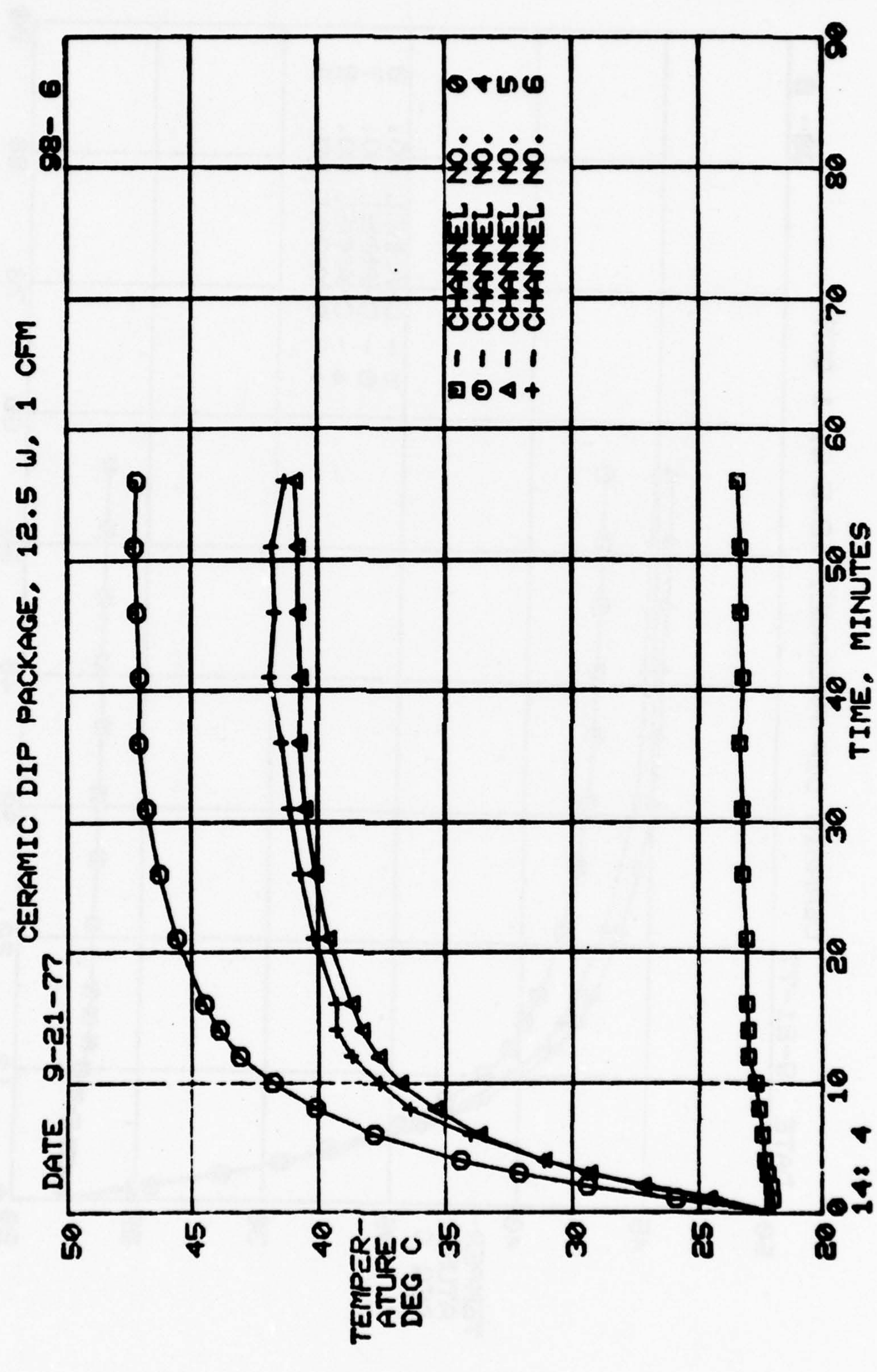
CERAMIC DIP PACKAGE, 25 W, 1 CFM

TEST STARTING DATE: 9-21-77 REQ. NO. 98 RUN NO. 5

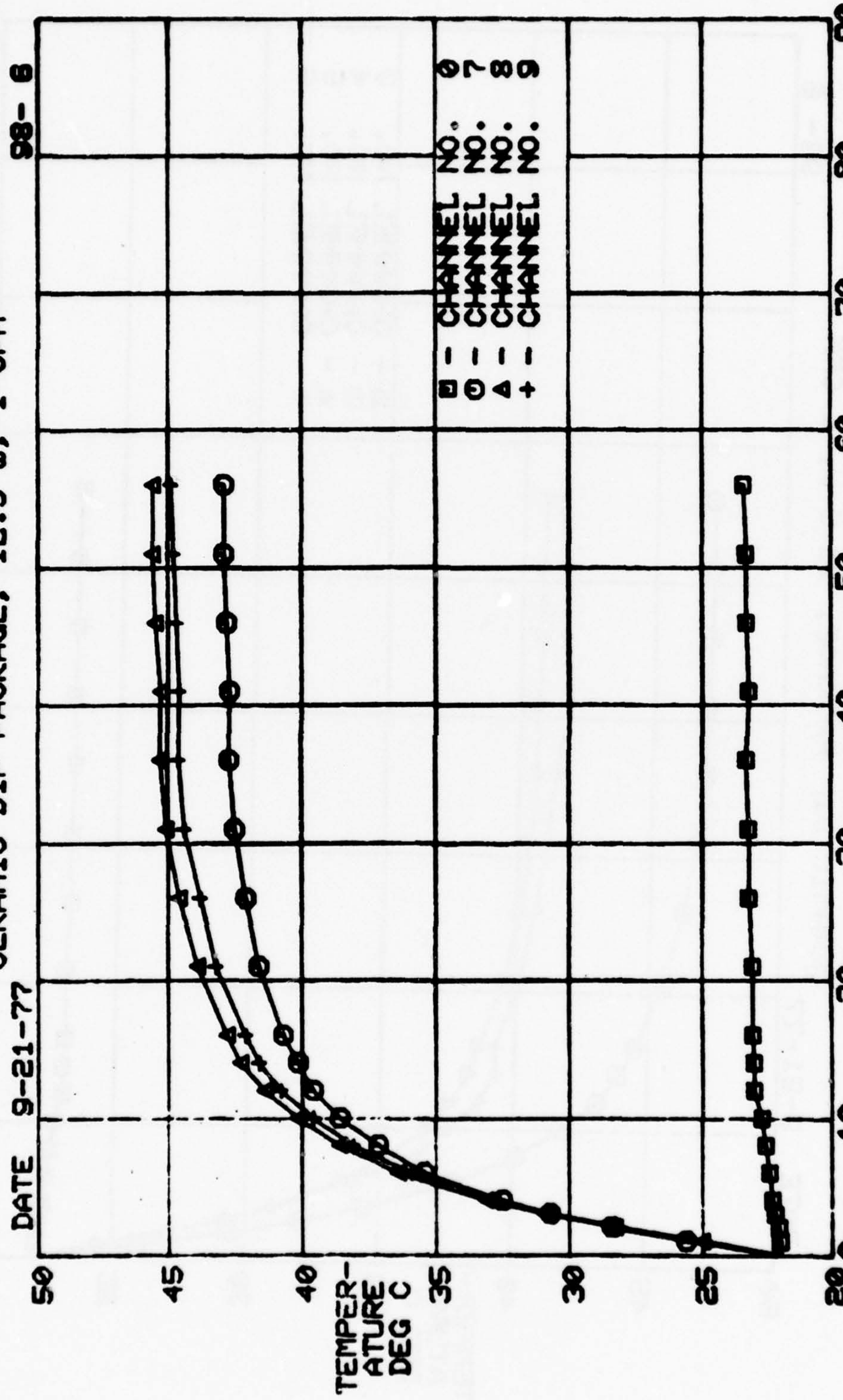
CHAN. NO.	MIN. VALUE	MAX. VALUE	MAX. GRADIENT	BEGIN. ELAPSED TIME
0	22.4 C	25.6 C	.30 C/MIN	5 MIN
1	22.3 C	64.9 C	9.10 C/MIN	1 MIN
2	22.3 C	64.6 C	9. C/MIN	1 MIN
3	22.3 C	72.7 C	9.2 C/MIN	1 MIN
4	22.3 C	73.1 C	8.8 C/MIN	1 MIN
5	22.3 C	59.7 C	5.7 C/MIN	1 MIN
6	22.3 C	62.3 C	5.59 C/MIN	2 MIN
7	22.3 C	63.9 C	7.9 C/MIN	1 MIN
8	22.3 C	69.7 C	6.80 C/MIN	1 MIN
9	22.3 C	68.4 C	6.6 C/MIN	1 MIN



DATE 9-21-77
CERAMIC DIP PACKAGE, 12.5 W, 1 CFM
98- 6
14: 4
TEMPER-
ATURE
DEG C
50
45
40
35
30
25
20
0
10
20
30
40
50
60
70
80
90
TIME, MINUTES
□ - CHANNEL NO. 0
⊙ - CHANNEL NO. 1
△ - CHANNEL NO. 2
+ - CHANNEL NO. 3



DATE 9-21-77 CERAMIC DIP PACKAGE, 12.5 W, 1 CFM
98- 6
□ - CHANNEL NO. 3
⊙ - CHANNEL NO. 4
△ - CHANNEL NO. 5
+ - CHANNEL NO. 6
TEMPER-
ATURE
DEG C
50
45
40
35
30
25
20
0
10
20
30
40
50
60
70
80
90
14: 4
TIME, MINUTES



CERAMIC DIP PACKAGE, 12.5 W, 1 CFM
DATE 9-21-77
TEMPER-
ATURE
DEG C
20
25
30
35
40
45
50
0
10
20
30
40
50
60
70
80
90
14: 4
TIME, MINUTES
☐ – CHANNEL NO. 6
○ – CHANNEL NO. 7
△ – CHANNEL NO. 8
+ – CHANNEL NO. 9

CERAMIC DIP PACKAGE, 12.5 W, 1 CFM

TEST STARTING DATE: 9-21-77 REQ. NO. 98 RUN NO. 6

			CHANNEL NUMBER					
SCAN	HR:MN	ELAPSED TIME	0	1	2	3	4	5
1	14: 4	0	22. C	22. C	22.1C	22.1C	22.1C	22. C
2	14: 5	1	22. C	26.2C	26.2C	26.3C	25.9C	24.6C
3	14: 6	2	22.1C	28.9C	28.9C	29.6C	29.4C	27.2C
4	14: 7	3	22.2C	31.1C	31.2C	32.3C	32.1C	29.3C
5	14: 8	4	22.3C	32.9C	33. C	34.6C	34.4C	31.1C
6	14:10	6	22.4C	35.8C	35.9C	37.9C	37.8C	33.7C
7	14:12	8	22.6C	37.7C	37.8C	40.1C	40.1C	35.4C
8	14:14	10	22.7C	39. C	39.1C	41.7C	41.8C	36.8C
9	14:16	12	23. C	40.1C	40.1C	43.1C	43.1C	37.7C
10	14:18	14	23. C	40.7C	40.7C	43.8C	43.9C	38.3C
11	14:20	16	23.1C	41.1C	41.1C	44.6C	44.5C	38.7C
12	14:25	21	23.1C	41.9C	41.9C	45.5C	45.6C	39.6C
13	14:30	26	23.2C	42.5C	42.5C	46.2C	46.3C	40.1C
14	14:35	31	23.2C	42.9C	42.9C	46.9C	46.8C	40.5C
15	14:40	36	23.3C	43.1C	43.1C	47.1C	47.1C	40.7C
16	14:45	41	23.2C	43.1C	43.1C	47.1C	47.1C	40.7C
17	14:50	46	23.3C	43.2C	43.2C	47.1C	47.2C	40.8C
18	14:55	51	23.3C	43.3C	43.2C	47.2C	47.3C	40.8C
19	15: 0	56	23.4C	43.2C	43.3C	47.3C	47.2C	40.9C

CERAMIC DIP PACKAGE, 12.5 W, 1 CFM

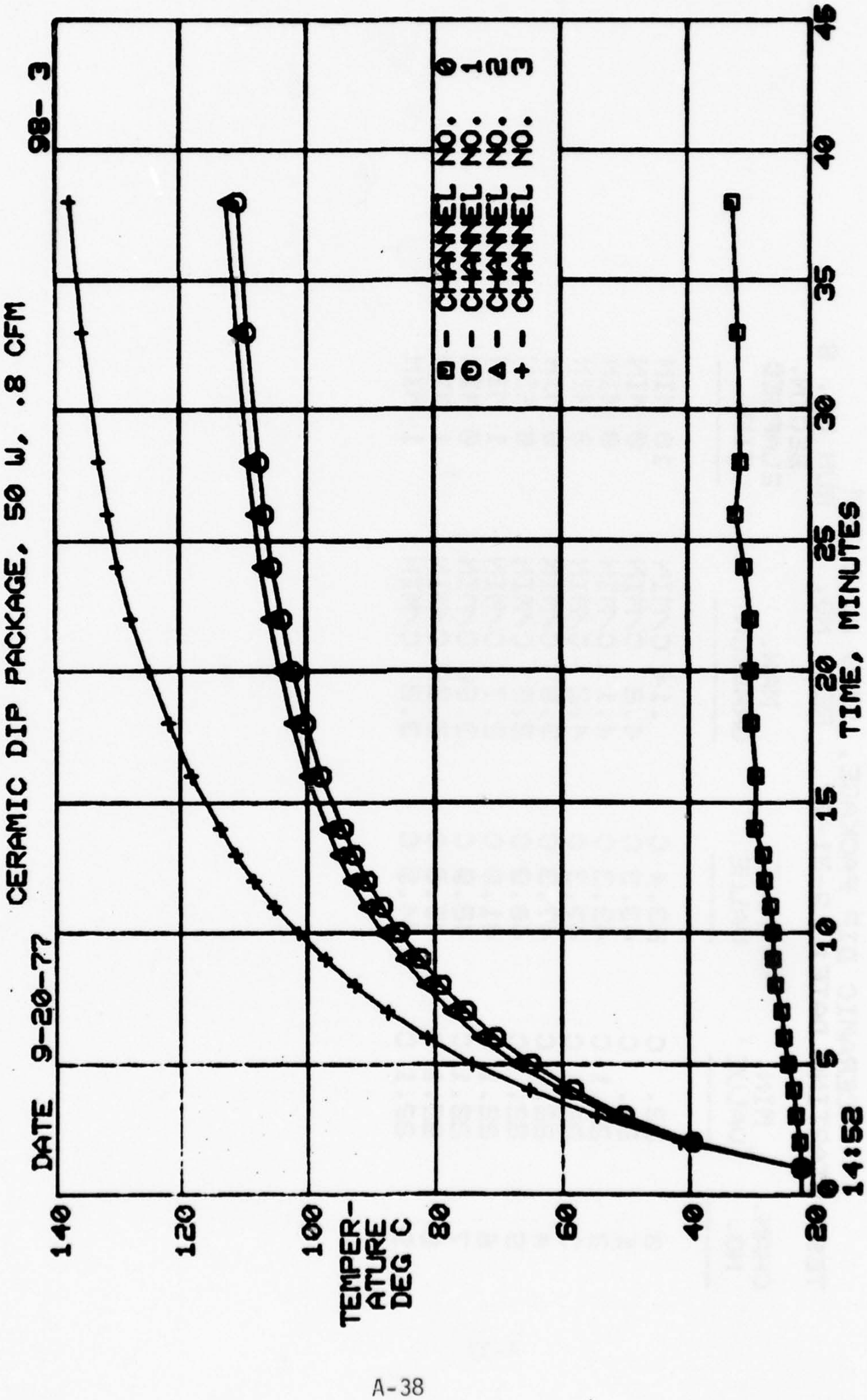
TEST STARTING DATE: 9-21-77 REQ. NO. 98 RUN NO. 6

			CHANNEL NUMBER			
SCAN	HR:MN	ELAPSED TIME	6	7	8	9
1	14: 4	0	22.1C	22.1C	22.1C	22.1C
2	14: 5	1	24.3C	25.6C	25. C	24.9C
3	14: 6	2	27. C	28.4C	28.3C	28.1C
4	14: 7	3	29.4C	30.7C	30.9C	30.7C
5	14: 8	4	31.1C	32.5C	33.1C	32.7C
6	14:10	6	34. C	35.4C	36.4C	35.9C
7	14:12	8	36.4C	37.2C	38.6C	38.1C
8	14:14	10	37.6C	38.6C	40.2C	39.6C
9	14:16	12	38.7C	39.6C	41.4C	40.8C
10	14:18	14	39.3C	40.2C	42.3C	41.6C
11	14:20	16	39.3C	40.7C	42.8C	42.1C
12	14:25	21	40.2C	41.6C	43.9C	43.2C
13	14:30	26	40.7C	42.1C	44.6C	43.8C
14	14:35	31	41.1C	42.5C	45.1C	44.4C
15	14:40	36	41.4C	42.7C	45.3C	44.6C
16	14:45	41	41.9C	42.7C	45.3C	44.6C
17	14:50	46	41.7C	42.8C	45.5C	44.7C
18	14:55	51	41.8C	42.9C	45.6C	44.8C
19	15: 0	56	41.3C	42.9C	45.6C	44.9C

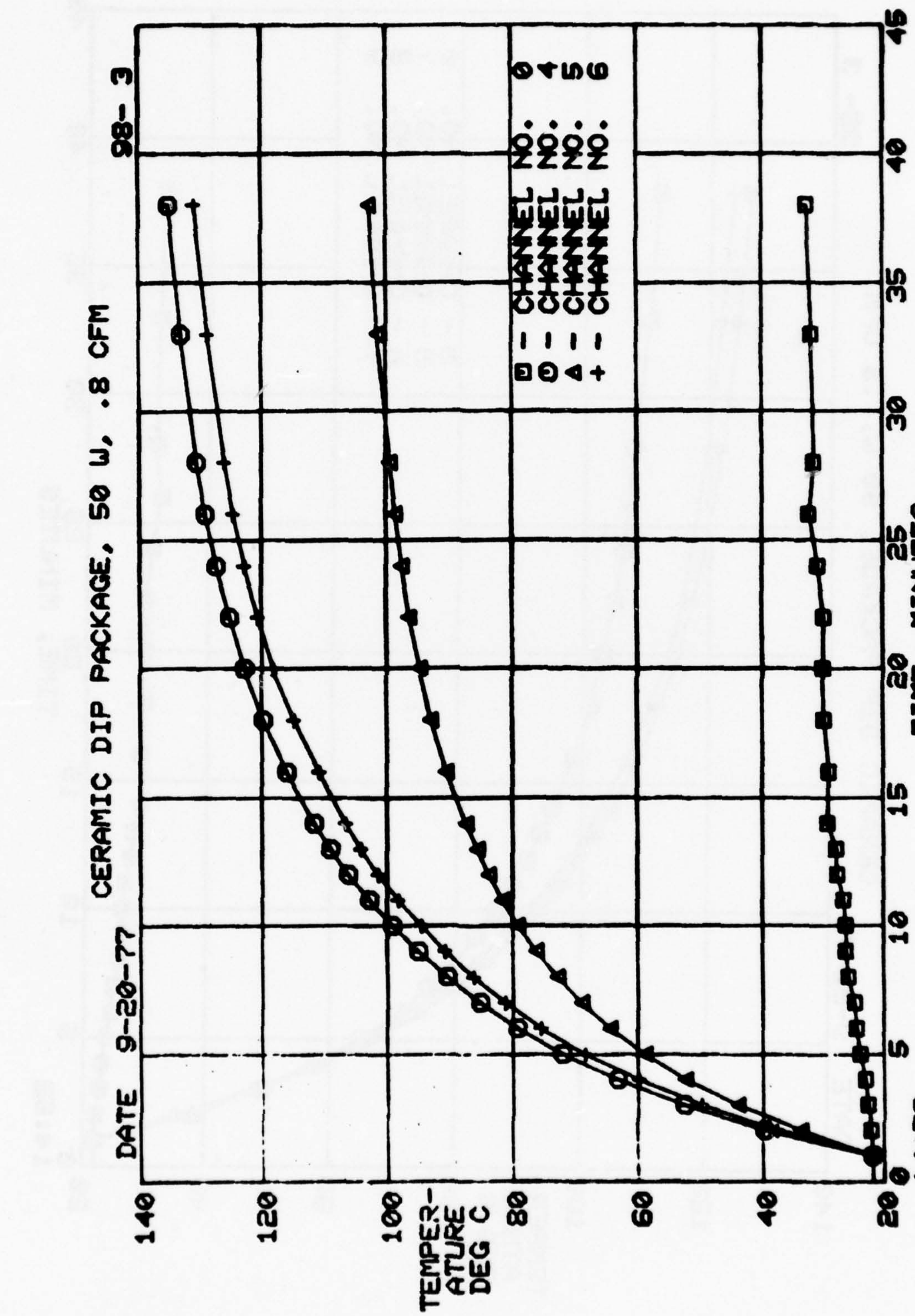
CERAMIC DIP PACKAGE, 12.5 W, 1 CFM

TEST STARTING DATE: 9-21-77 REQ. NO. 98 RUN NO. 6

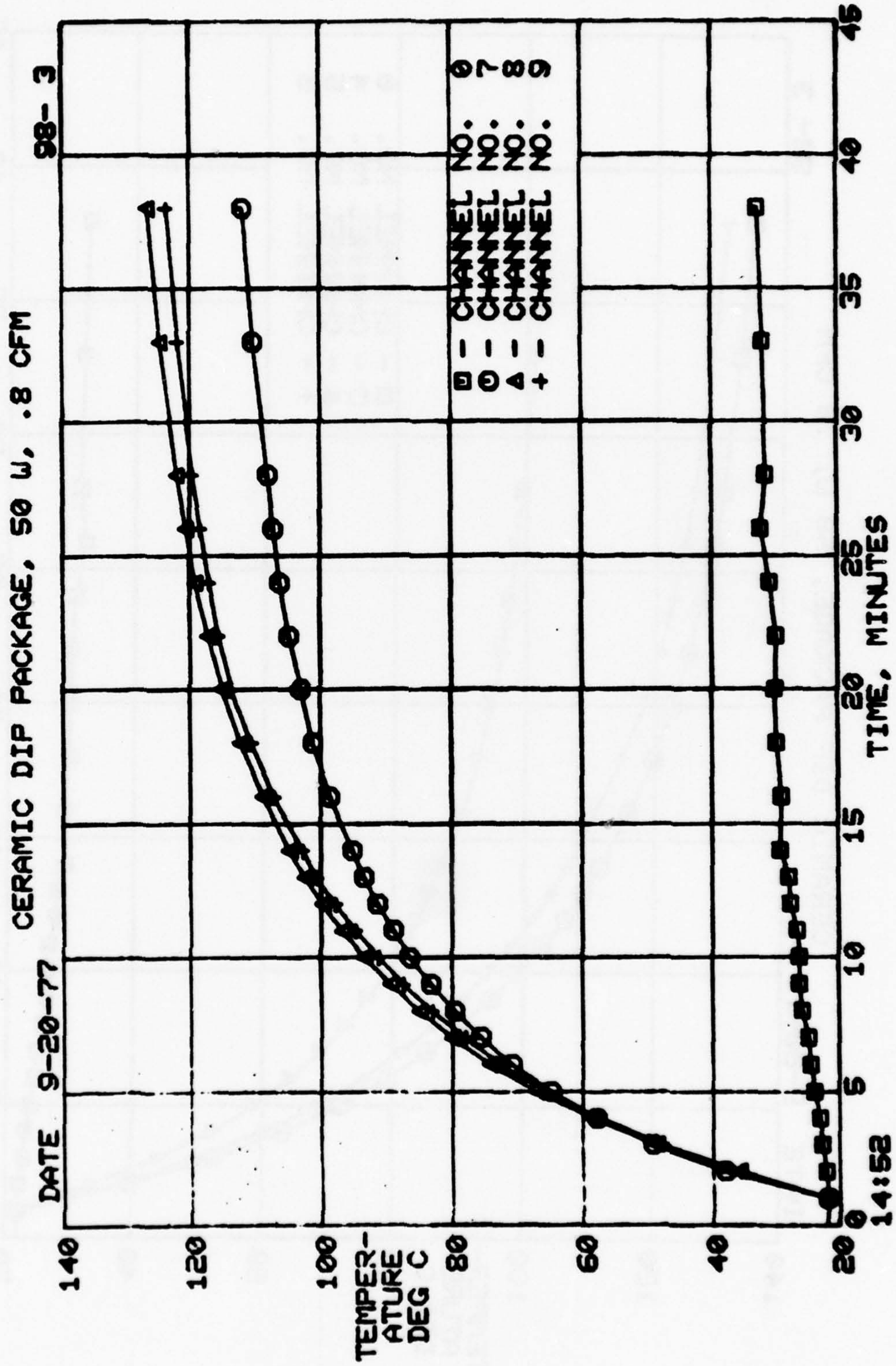
CHAN. NO.	MIN. VALUE	MAX. VALUE	MAX. GRADIENT	BEGIN. ELAPSED TIME
0	22. C	23.4 C	.14 C/MIN	10 MIN
1	22. C	43.3 C	4.2 C/MIN	0 MIN
2	22.1 C	43.3 C	4.1 C/MIN	0 MIN
3	22.1 C	47.3 C	4.2 C/MIN	0 MIN
4	22.1 C	47.3 C	3.8 C/MIN	0 MIN
5	22. C	40.9 C	2.6 C/MIN	0 MIN
6	22.1 C	41.9 C	2.7 C/MIN	1 MIN
7	22.1 C	42.9 C	3.50 C/MIN	0 MIN
8	22.1 C	45.6 C	3.29 C/MIN	1 MIN
9	22.1 C	44.9 C	3.2 C/MIN	1 MIN



CERAMIC DIP PACKAGE, 50 W, .8 CFM
DATE 9-20-77
98- 3
14:52
TEMPER-
ATURE
DEG C
140
120
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
TIME, MINUTES
□ — CHANNEL NO. 0
○ — CHANNEL NO. 1
△ — CHANNEL NO. 2
+ — CHANNEL NO. 3



CERAMIC DIP PACKAGE, 50 W, .8 CFM
DATE 9-20-77
98- 3
□ - CHANNEL NO. 3
⊙ - CHANNEL NO. 4
△ - CHANNEL NO. 5
+ - CHANNEL NO. 6
TEMPER-
ATURE
DEG C
140
120
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
14:52
TIME, MINUTES



DATE 9-20-77
CERAMIC DIP PACKAGE, 50 W, .8 CFM
98- 3
□ - CHANNEL NO. 6
⊙ - CHANNEL NO. 7
△ - CHANNEL NO. 8
+ - CHANNEL NO. 9
TEMPER-
ATURE
DEG C
140
120
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
14:52
TIME, MINUTES

CERAMIC DIP PACKAGE, 50 W, .8 CFM

TEST STARTING DATE: 9-20-77 REQ. NO. 98 RUN NO. 3

SCAN	HR:MN	ELAPSED TIME	CHANNEL NUMBER 0	1	2	3	4	5
1	14:52	0	21.8C	21.9C	21.9C	21.9C	21.9C	21.9C
2	14:53	1	21.8C	21.9C	21.9C	21.9C	21.9C	21.9C
3	14:54	2	22. C	39.4C	40.3C	41.5C	39.7C	33.7C
4	14:55	3	22.6C	50.2C	51.8C	54.7C	52.7C	44.1C
5	14:56	4	23.1C	58.2C	60.3C	65.3C	63.2C	52.4C
6	14:57	5	23.9C	64.9C	67.3C	74.2C	72.1C	58.9C
7	14:58	6	24.4C	70.4C	73.1C	81.3C	79.2C	64.4C
8	14:59	7	24.8C	75.1C	77.6C	87.4C	85.2C	69.1C
9	15: 0	8	25.9C	79.1C	81.6C	92.7C	90.4C	72.9C
10	15: 1	9	26.3C	82.3C	85. C	97.3C	95.1C	76.3C
11	15: 2	10	26.3C	85.6C	88.3C	101.4C	99.2C	79.2C
12	15: 3	11	26.7C	88.3C	90.9C	105.2C	102.9C	81.6C
13	15: 4	12	27.7C	90.6C	93.2C	108.4C	106.2C	83.8C
14	15: 5	13	27.9C	92.7C	95.2C	111.2C	109.1C	85.7C
15	15: 6	14	29.2C	94.4C	96.9C	113.7C	111.6C	87.4C
16	15: 8	16	29.1C	97.8C	100.1C	118.2C	116. C	90.6C
17	15:10	18	29.9C	100.2C	102.5C	121.9C	119.8C	93.1C
18	15:12	20	30. C	102.3C	104.3C	125.1C	122.9C	94.9C
19	15:14	22	29.8C	103.9C	105.9C	127.8C	125.3C	96.4C
20	15:16	24	30.8C	105.4C	107.3C	130. C	127.4C	97.7C
21	15:18	26	32.2C	106.6C	108.3C	131.7C	129.2C	98.6C
22	15:20	28	31.5C	107.4C	109.2C	133.1C	130.6C	99.5C
23	15:25	33	31.8C	109.4C	111.1C	135.8C	133.3C	101.4C
24	15:30	38	32.7C	110.9C	112.7C	137.9C	135.3C	102.9C

CERAMIC DIP PACKAGE, 50 W, .8 CFM

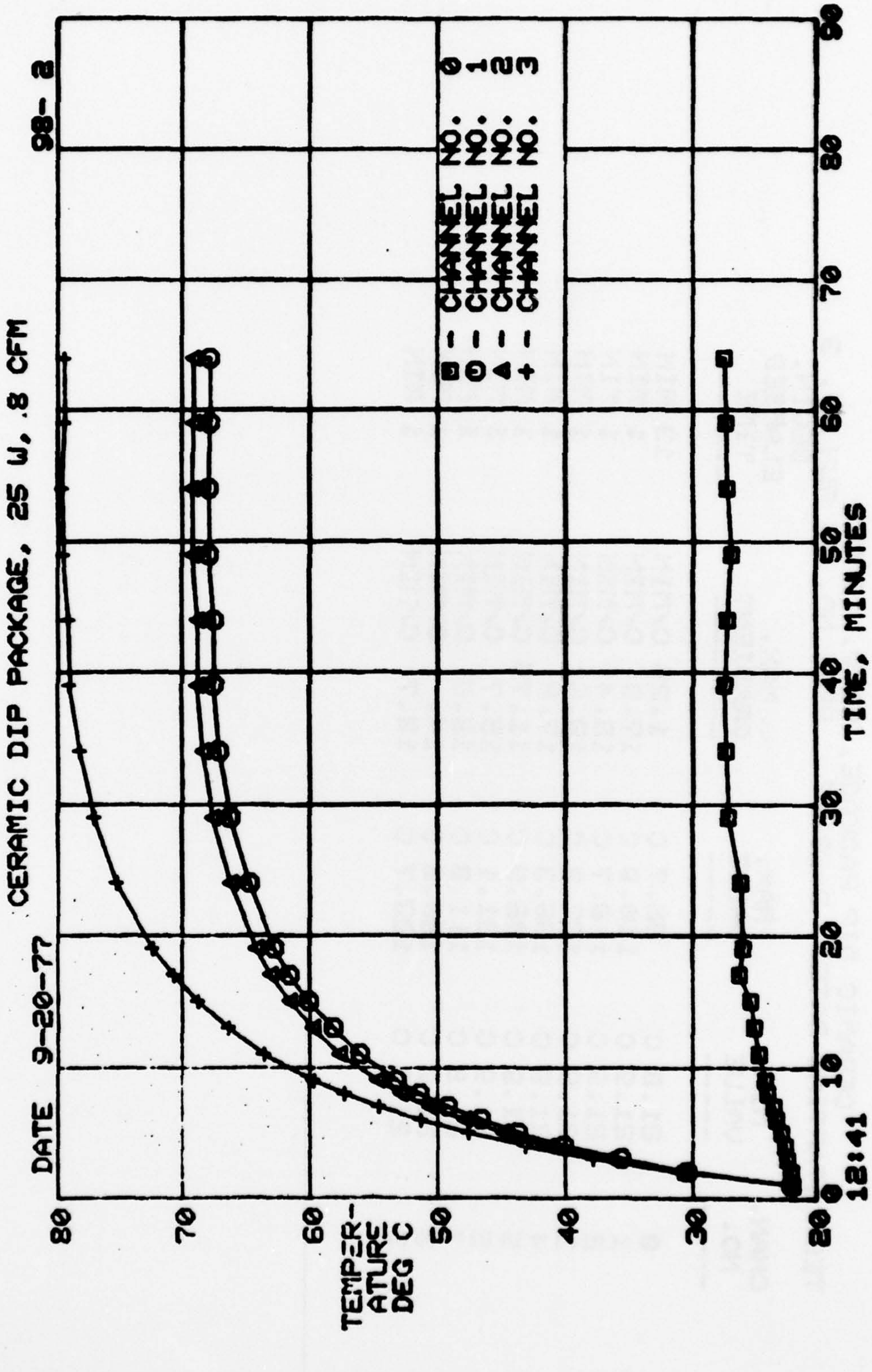
TEST STARTING DATE: 9-20-77 REQ. NO. 98 RUN NO. 3

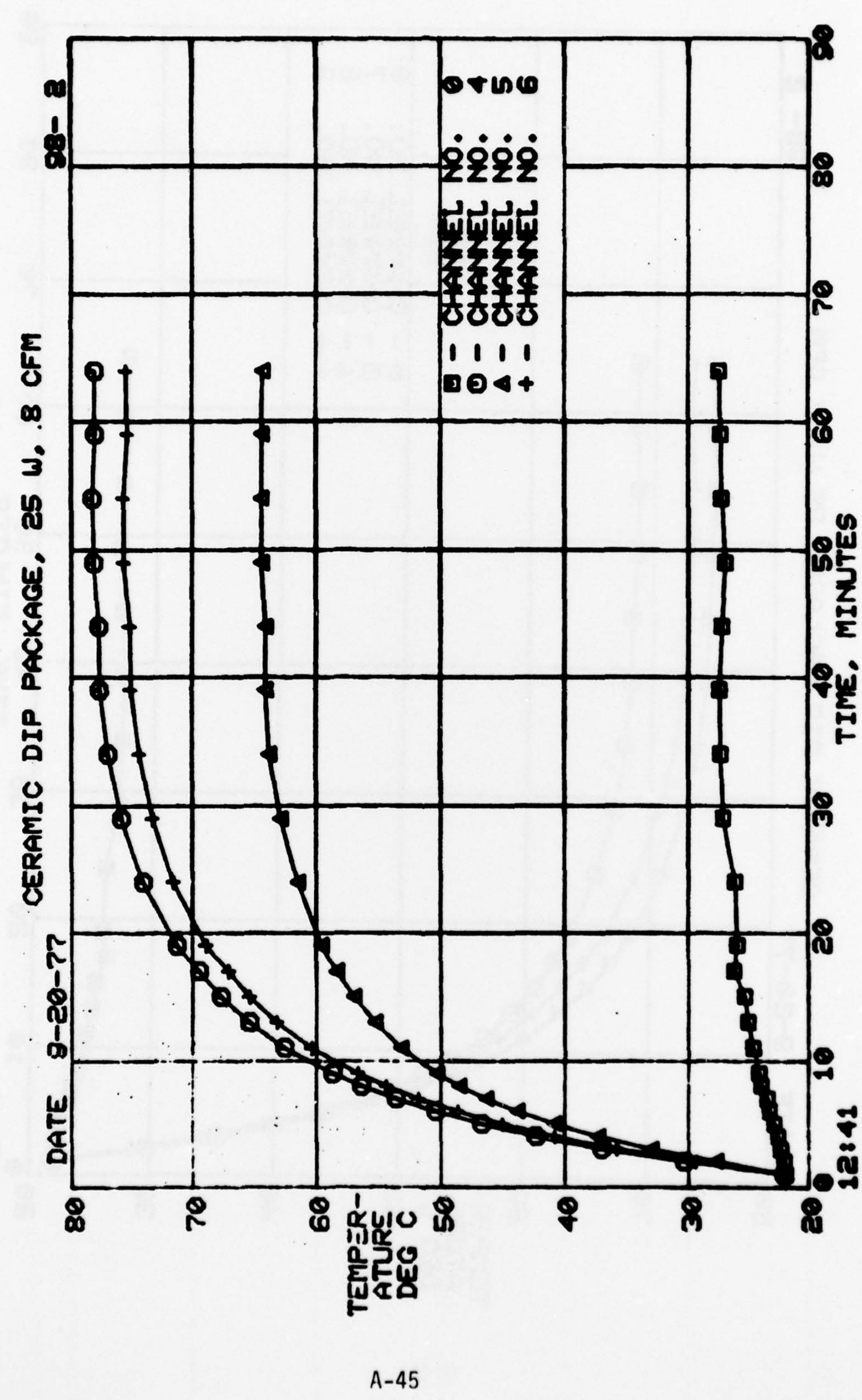
		ELAPSED	CHANNEL NUMBER			
SCAN	HR:MN	TIME	6	7	8	9
1	14:52	0	21.9C	21.9C	21.9C	21.9C
2	14:53	1	21.9C	21.8C	21.9C	21.9C
3	14:54	2	37.6C	38. C	35.9C	35.6C
4	14:55	3	49.9C	49.2C	48.6C	47.6C
5	14:56	4	59.9C	57.8C	58.7C	57.4C
6	14:57	5	68.4C	64.9C	67.1C	65.6C
7	14:58	6	75.4C	70.8C	74.2C	72.6C
8	14:59	7	81.2C	75.6C	80. C	78.1C
9	15: 0	8	86.2C	79.6C	85.1C	83.1C
10	15: 1	9	90.9C	83.2C	89.4C	87.5C
11	15: 2	10	94.7C	86.4C	93.4C	91.3C
12	15: 3	11	98.3C	89.1C	96.9C	94.9C
13	15: 4	12	101.4C	91.5C	99.8C	97.8C
14	15: 5	13	104.2C	93.5C	102.4C	100.6C
15	15: 6	14	106.6C	95.3C	104.8C	102.9C
16	15: 8	16	110.8C	98.7C	108.9C	107.2C
17	15:10	18	114.9C	101.2C	112.3C	110.7C
18	15:12	20	118.2C	103.1C	115.1C	113.6C
19	15:14	22	120.7C	104.8C	117.3C	115.7C
20	15:16	24	122.8C	106.2C	119.2C	117. C
21	15:18	26	124.6C	107.2C	120.7C	118.5C
22	15:20	28	126.1C	108.1C	122. C	119.7C
23	15:25	33	128.9C	110.2C	124.6C	121.8C
24	15:30	38	131.1C	111.8C	126.6C	123.7C

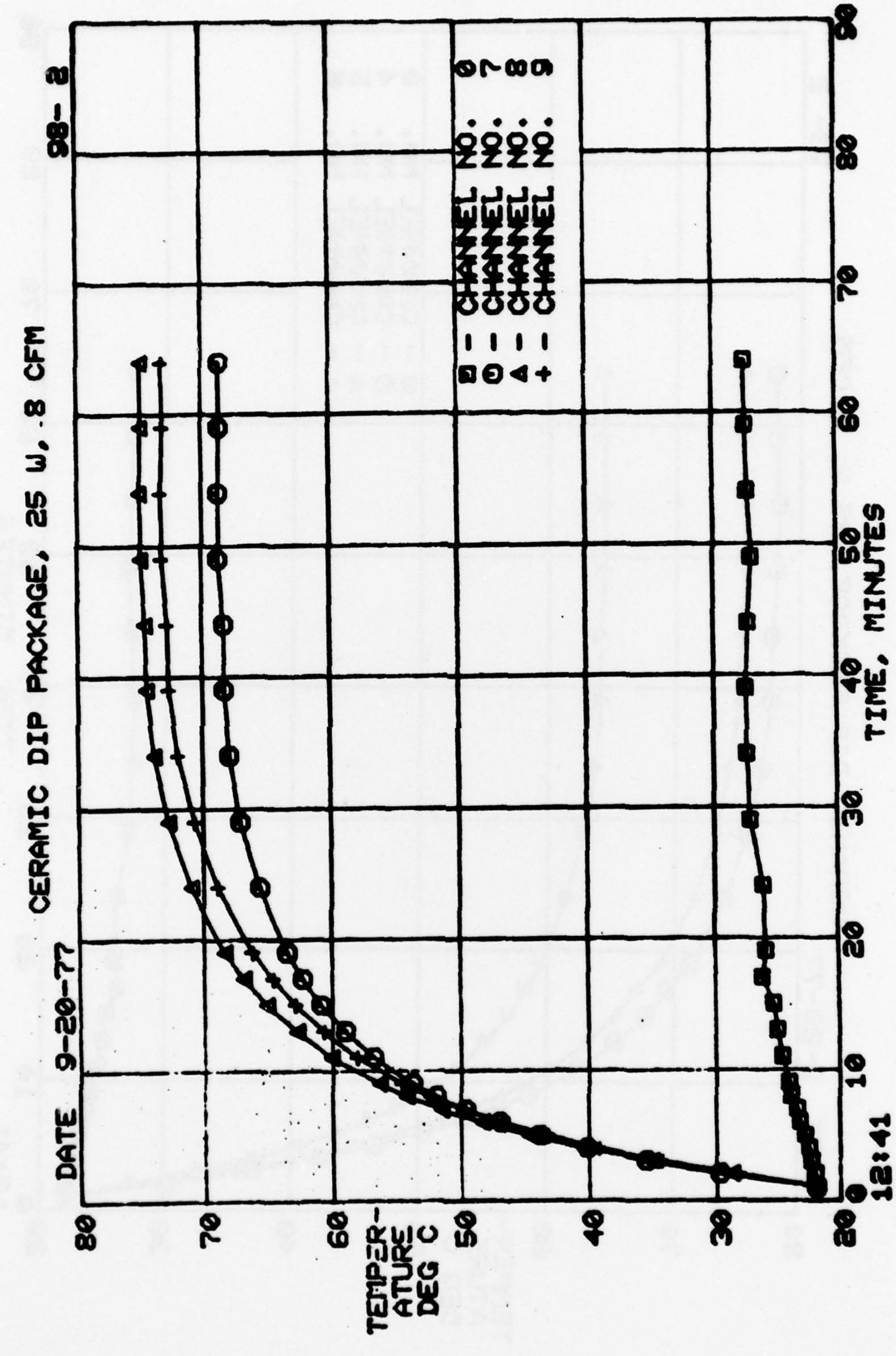
CERAMIC DIP PACKAGE, 50 W, .8 CFM

TEST STARTING DATE: 9-20-77 REQ. NO. 98 RUN NO. 3

CHAN. NO.	MIN. VALUE	MAX. VALUE	MAX. GRADIENT	BEGIN. ELAPSED TIME
0	21.8 C	32.7 C	1.29 C/MIN	13 MIN
1	21.9 C	110.9 C	17.5 C/MIN	1 MIN
2	21.9 C	112.7 C	18.4 C/MIN	1 MIN
3	21.9 C	137.9 C	19.6 C/MIN	1 MIN
4	21.9 C	135.3 C	17.8 C/MIN	1 MIN
5	21.9 C	102.9 C	11.79 C/MIN	1 MIN
6	21.9 C	131.1 C	15.7 C/MIN	1 MIN
7	21.8 C	111.8 C	16.2 C/MIN	1 MIN
8	21.9 C	126.6 C	14. C/MIN	1 MIN
9	21.9 C	123.7 C	13.7 C/MIN	[illegible] MIN


DATE 9-20-77
CERAMIC DIP PACKAGE, 25 W, .8 CFM
98- 2
□ - CHANNEL NO. 0
⊙ - CHANNEL NO. 1
▲ - CHANNEL NO. 2
+ - CHANNEL NO. 3
TEMPER-
ATURE
DEG C
80
70
60
50
40
30
20
0
10
20
30
40
50
60
70
80
90
18:41
TIME, MINUTES


DATE 9-20-77
CERAMIC DIP PACKAGE, 25 W, .8 CFM
98- 8
□ - CHANNEL NO. 3
⊙ - CHANNEL NO. 4
△ - CHANNEL NO. 5
+ - CHANNEL NO. 6
TEMPER-
ATURE
DEG C
80
70
60
50
40
30
20
0
10
20
30
40
50
60
70
80
90
12:41
TIME, MINUTES


DATE 9-20-77
CERAMIC DIP PACKAGE, 25 W, .8 CFM
98- 2
□ — CHANNEL NO. 6
⊙ — CHANNEL NO. 7
△ — CHANNEL NO. 8
+ — CHANNEL NO. 9
TEMPER-
ATURE
DEG C
80
70
60
50
40
30
20
0
10
20
30
40
50
60
70
80
90
12:41
TIME, MINUTES

CERAMIC DIP PACKAGE, 25 W, 8 CFM

TEST STARTING DATE: 9-20-77 REQ. NO. 98 RUN NO. 2

SCAN	HR:MN	ELAPSED TIME	CHANNEL NUMBER 0	1	2	3	4	5
1	12:41	0	21.9C	21.9C	22. C	22. C	22. C	21.9C
2	12:42	1	21.9C	22. C	22. C	22. C	22. C	21.9C
3	12:43	2	22.1C	30.4C	30.8C	31.1C	30.3C	27.7C
4	12:44	3	22.3C	35.6C	36.5C	37.8C	37. C	33. C
5	12:45	4	22.5C	40.1C	41.3C	43.1C	42.3C	37.3C
6	12:46	5	22.8C	43.7C	44.9C	47.8C	46.7C	40.8C
7	12:47	6	23.2C	46.6C	47.9C	51.3C	50.4C	43.8C
8	12:48	7	23.4C	49.2C	50.6C	54.6C	53.6C	46.3C
9	12:49	8	23.9C	51.4C	52.9C	57.3C	56.4C	48.5C
10	12:50	9	24.1C	53.2C	54.7C	59.7C	58.7C	50.3C
11	12:52	11	24.6C	56.1C	57.7C	63.6C	62.6C	53.2C
12	12:54	13	25. C	58.2C	59.8C	66.4C	65.4C	55.3C
13	12:56	15	25.3C	60.1C	61.6C	68.8C	67.7C	57. C
14	12:58	17	26.2C	61.6C	63.1C	70.7C	69.5C	58.4C
15	13: 0	19	25.9C	62.8C	64.2C	72.4C	71.3C	59.6C
16	13: 5	24	26.1C	64.7C	66.2C	75.3C	74.1C	61.5C
17	13:10	29	27.1C	66.2C	67.6C	77.1C	75.9C	62.9C
18	13:15	34	27.3C	67.1C	68.4C	78.3C	77. C	63.8C
19	13:20	39	27.4C	67.5C	68.8C	79.1C	77.7C	64.1C
20	13:25	44	27.2C	67.5C	68.8C	79.2C	77.8C	64.1C
21	13:30	49	26.9C	67.9C	69.2C	79.6C	78.2C	64.4C
22	13:35	54	27.2C	67.9C	69.2C	79.7C	78.3C	64.4C
23	13:40	59	27.3C	67.8C	69.1C	79.5C	78.1C	64.4C
24	13:45	64	27.4C	67.8C	69.1C	79.5C	78.1C	64.3C

CERAMIC DIP PACKAGE, 25 W, .8 CFM

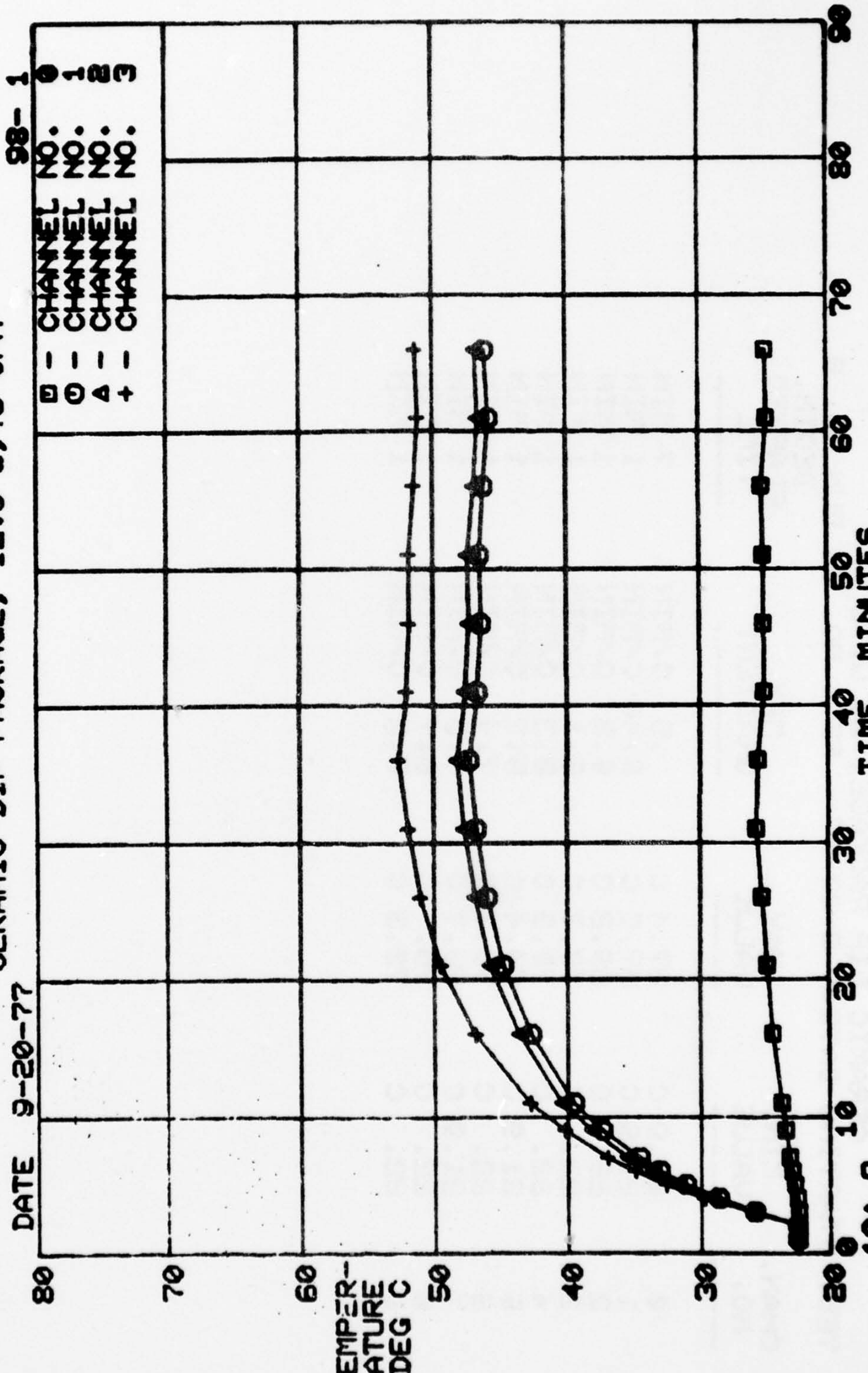
TEST STARTING DATE: 9-20-77 REQ. NO. 98 RUN NO. 2

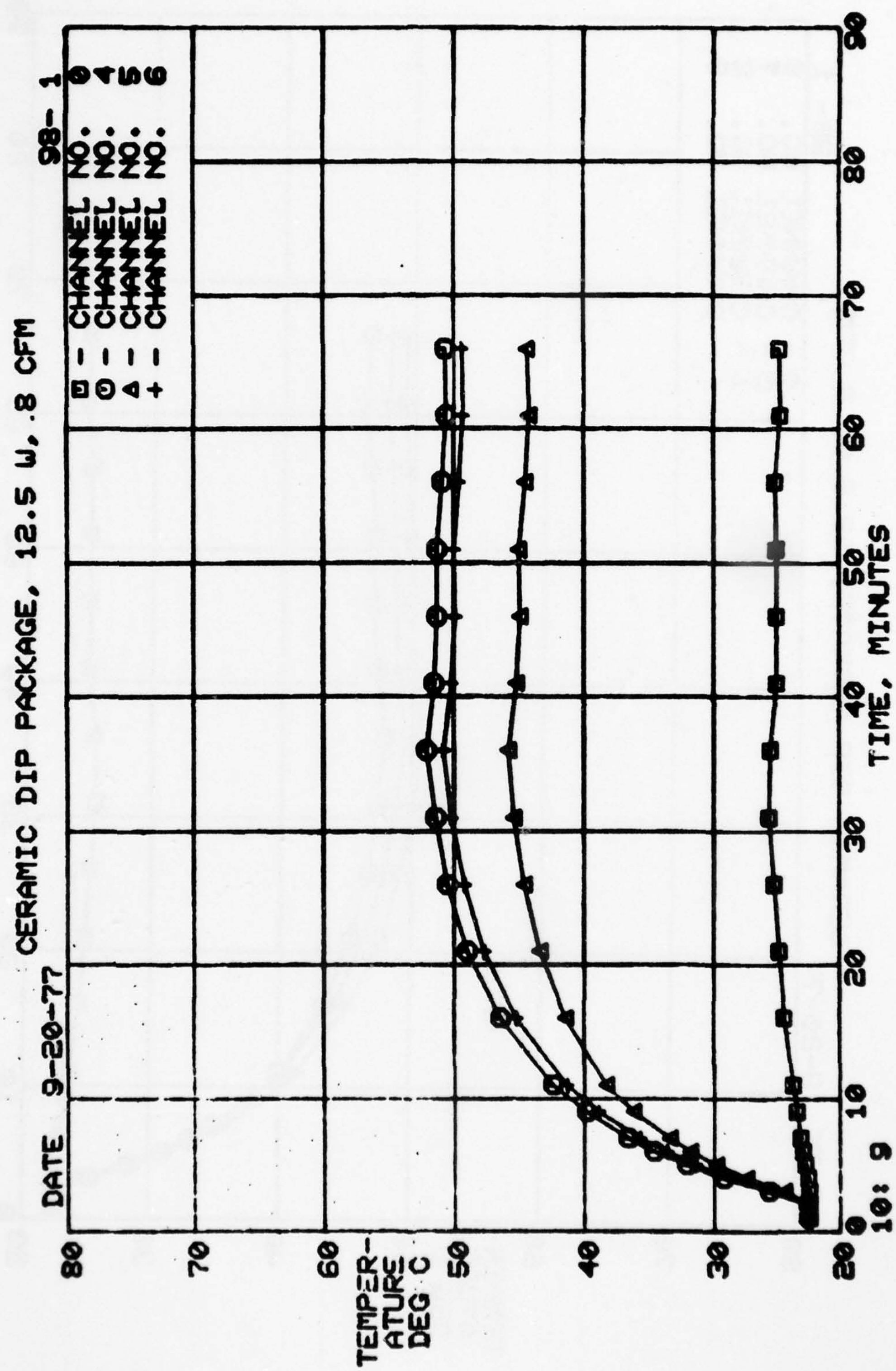
			CHANNEL NUMBER			
SCAN	HR:MN	ELAPSED TIME	6	7	8	9
1	12:41	0	22. C	21.9C	22. C	22. C
2	12:42	1	22. C	21.9C	22. C	22. C
3	12:43	2	29.4C	29.7C	28.7C	28.2C
4	12:44	3	35.8C	35.5C	35.2C	34.3C
5	12:45	4	40.8C	40.1C	40.4C	39.2C
6	12:46	5	45. C	43.8C	44.7C	43.2C
7	12:47	6	48.6C	46.9C	48.3C	46.7C
8	12:48	7	51.8C	49.6C	51.5C	49.7C
9	12:49	8	54.4C	51.9C	54.2C	52.3C
10	12:50	9	56.7C	53.8C	56.4C	54.6C
11	12:52	11	60.4C	56.8C	60.1C	58.1C
12	12:54	13	63.2C	59. C	62.8C	60.7C
13	12:56	15	65.4C	60.9C	65.1C	62.9C
14	12:58	17	67.1C	62.3C	66.9C	64.6C
15	13: 0	19	68.9C	63.5C	68.4C	66.2C
16	13: 5	24	71.6C	65.6C	71. C	68.9C
17	13:10	29	73.3C	67.1C	72.8C	70.7C
18	13:15	34	74.4C	67.9C	73.9C	72. C
19	13:20	39	75.1C	68.3C	74.5C	72.7C
20	13:25	44	75.2C	68.3C	74.6C	72.8C
21	13:30	49	75.7C	68.7C	74.9C	73.2C
22	13:35	54	75.7C	68.7C	75. C	73.3C
23	13:40	59	75.4C	68.6C	74.9C	73.1C
24	13:45	64	75.5C	68.6C	74.9C	73.2C

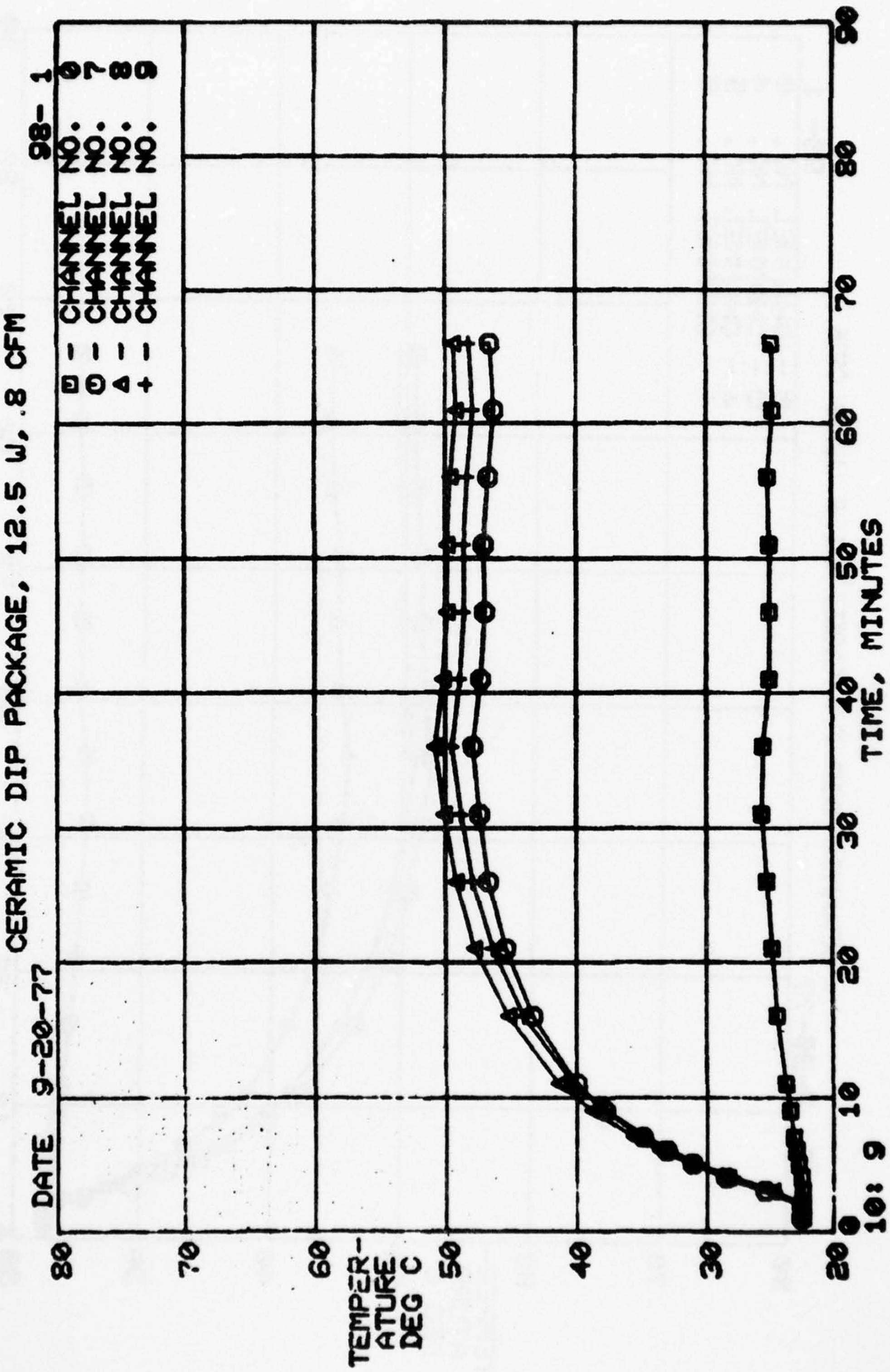
CERAMIC DIP PACKAGE, 25 W, 8 CFM

TEST STARTING DATE: 9-20-77 REQ. NO. 98 RUN NO. 2

CHAN. NO.	MIN. VALUE	MAX. VALUE	MAX. GRADIENT	BEGIN. ELAPSED TIME
0	21.9 C	27.4 C	.5 C/MIN	7 MIN
1	21.9 C	67.9 C	8.40 C/MIN	1 MIN
2	22. C	69.2 C	8.8 C/MIN	1 MIN
3	22. C	79.7 C	9.1 C/MIN	1 MIN
4	22. C	78.3 C	8.3 C/MIN	1 MIN
5	21.9 C	64.4 C	5.8 C/MIN	1 MIN
6	22. C	75.7 C	7.4 C/MIN	1 MIN
7	21.9 C	68.7 C	7.8 C/MIN	1 MIN
8	22. C	75. C	6.7 C/MIN	1 MIN
9	22. C	73.3 C	6.2 C/MIN	1 MIN


DATE 9-20-77 CERAMIC DIP PACKAGE, 12.5 W, .8 CFM 98-1
□ - CHANNEL NO. 0
⊙ - CHANNEL NO. 1
△ - CHANNEL NO. 2
+ - CHANNEL NO. 3
TEMPER-
ATURE
DEG C
20
30
40
50
60
70
80
10: 9
0
10
20
30
40
50
60
70
80
90
TIME, MINUTES


CERAMIC DIP PACKAGE, 12.5 W, .8 CFM
DATE 9-20-77
98-1
□ - CHANNEL NO. 3
⊙ - CHANNEL NO. 4
△ - CHANNEL NO. 5
+ - CHANNEL NO. 6
TEMPER-
ATURE
DEG C
80
70
60
50
40
30
20
10: 9
0
10
20
30
40
50
60
70
80
90
TIME, MINUTES



DATE 9-20-77
CERAMIC DIP PACKAGE, 12.5 W, .8 CFM
98-1
□ — CHANNEL NO. 6
⊙ — CHANNEL NO. 7
△ — CHANNEL NO. 8
+ — CHANNEL NO. 9
TEMPER-
ATURE
DEG C
80
70
60
50
40
30
20
10: 9
0
10
20
30
40
50
60
70
80
90
TIME, MINUTES

CERAMIC DIP PACKAGE, 12.5 W, 8 CFM

TEST STARTING DATE: 9-20-77 REQ. NO. 98 RUN NO. 1

SCAN	HR:MN	ELAPSED TIME	CHANNEL NUMBER 0	1	2	3	4	5
1	10: 9	0	22.4C	22.6C	22.6C	22.6C	22.6C	22.6C
2	10:10	1	22.4C	22.6C	22.6C	22.6C	22.6C	22.6C
3	10:11	2	22.4C	22.5C	22.5C	22.5C	22.6C	22.5C
4	10:12	3	22.4C	25.8C	25.9C	26. C	25.6C	24.4C
5	10:13	4	22.6C	28.6C	29.1C	29.7C	29.2C	27.4C
6	10:14	5	22.7C	31.1C	31.7C	32.6C	32.1C	29.8C
7	10:15	6	22.9C	33.1C	33.7C	34.9C	34.6C	31.8C
8	10:16	7	23.1C	34.7C	35.5C	37. C	36.6C	33.4C
9	10:18	9	23.4C	37.4C	38.2C	40.2C	39.8C	36.2C
10	10:20	11	23.7C	39.5C	40.4C	42.8C	42.4C	38.3C
11	10:25	16	24.4C	42.7C	43.6C	46.9C	46.4C	41.4C
12	10:30	21	24.8C	44.8C	45.8C	49.5C	49. C	43.4C
13	10:35	26	25.2C	46. C	46.9C	51. C	50.5C	44.6C
14	10:40	31	25.6C	46.8C	47.7C	51.9C	51.4C	45.4C
15	10:45	36	25.5C	47.3C	48.2C	52.6C	52.1C	45.8C
16	10:50	41	25. C	46.7C	47.6C	52. C	51.5C	45.2C
17	10:55	46	25. C	46.4C	47.3C	51.8C	51.3C	44.9C
18	11: 0	51	25. C	46.5C	47.4C	51.8C	51.3C	45. C
19	11: 5	56	25.1C	46.2C	46.9C	51.4C	50.9C	44.5C
20	11:10	61	24.7C	45.8C	46.6C	51.1C	50.6C	44.2C
21	11:15	66	24.8C	46.1C	46.8C	51.3C	50.7C	44.4C

CERAMIC DIP PACKAGE, 12.5 W, .8 CFM

TEST STARTING DATE: 9-20-77 REQ. NO. 98 RUN NO. 1

		ELAPSED	CHANNEL NUMBER			
SCAN	HR:MN	TIME	6	7	8	9
1	10: 9	0	22.6C	22.6C	22.6C	22.6C
2	10:10	1	22.6C	22.6C	22.6C	22.6C
3	10:11	2	22.6C	22.5C	22.6C	22.5C
4	10:12	3	25.2C	25.4C	24.8C	24.6C
5	10:13	4	28.7C	28.5C	28.3C	27.9C
6	10:14	5	31.4C	31.1C	31.1C	30.6C
7	10:15	6	33.7C	33.2C	33.6C	32.8C
8	10:16	7	35.7C	34.9C	35.6C	34.7C
9	10:18	9	38.9C	37.8C	38.8C	37.8C
10	10:20	11	41.3C	39.9C	41.3C	40.2C
11	10:25	16	45.2C	43.3C	45.2C	44. C
12	10:30	21	47.7C	45.4C	47.8C	46.4C
13	10:35	26	49.2C	46.7C	49.2C	47.9C
14	10:40	31	50.2C	47.4C	50.1C	48.8C
15	10:45	36	50.8C	47.9C	50.8C	49.5C
16	10:50	41	50.2C	47.3C	50.2C	48.9C
17	10:55	46	49.9C	47. C	49.9C	48.6C
18	11: 0	51	50. C	47.1C	49.9C	48.6C
19	11: 5	56	49.6C	46.7C	49.6C	48.3C
20	11:10	61	49.3C	46.3C	49.2C	47.9C
21	11:15	66	49.4C	46.6C	49.4C	48.2C

CERAMIC DIP PACKAGE, 12.5 W, .8 CFM

TEST STARTING DATE: 9-20-77 REQ. NO. 98 RUN NO. 1

CHAN. NO.	MIN. VALUE	MAX. VALUE	MAX. GRADIENT	BEGIN. ELAPSED TIME
0	22.4 C	25.6 C	.20 C/MIN	5 MIN
1	22.5 C	47.3 C	3.29 C/MIN	2 MIN
2	22.5 C	48.2 C	3.4 C/MIN	2 MIN
3	22.5 C	52.6 C	3.7 C/MIN	3 MIN
4	22.6 C	52.1 C	3.59 C/MIN	3 MIN
5	22.5 C	45.8 C	3. C/MIN	3 MIN
6	22.6 C	50.8 C	3.5 C/MIN	3 MIN
7	22.5 C	47.9 C	3.09 C/MIN	3 MIN
8	22.6 C	50.8 C	3.5 C/MIN	3 MIN
9	22.5 C	49.5 C	3.29 C/MIN	3 MIN

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